ON THE COVER

THE king size pipe shown on our front cover is the Soap Lake Siphon of the Columbia Basin Irrigation Project in East Central Washington. It is part of the system for distributing water impounded behind Grand Coulee Dam to a vast tract of land that is now almost desert dry. The siphon crosses the Lower Grand Coulee, a great gash carved eons ago by the Columbia River when it took a short cut to the Pacific Ocean. The pipe is 25 feet in outside diameter with walls of reinforced concrete 23 inches thick and a liner of quarter-inch steel plate. The Bureau of Reclamation states that it can carry enough water to supply 100 gallons a day to every inhabitant of Canada, Argentina, and Ecuador.

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IN THIS ISSUE

TUNGSTEN, a highly essential metal for waging modern warfare successfully, is again in the spotlight because of the Korean situation. Our leading article on the Hamme Mine in North Carolina is consequently timely. Figures compiled by the Bureau of Mines reveal that this deposit, which lay untouched until 1942, was the leading domestic source of tungsten in 1949.

•

AMERICANS who belabor the time it sometimes takes to obtain badly needed municipal improvements will learn from the article that starts on page 268 that Britons fare worse than we do in that respect. The history of the new Rimrose drainage sewer in suburban Liverpool encompasses 20 years of obstacles, delays, revisions of plans, and compromises, many of them unavoidable and some born of political complications. But, as it usually the case, all the difficulties were finally resolved and the area concerned is no longer threatened with flood damage.

•

THE description of the La Cave hydroelectric project (page 272) completes a series of four articles on current power developments on the Ottawa River. The La Cave construction, like that at Des Joachims, involved the excavating of a large volume of rock in a hurry. In both instances, the burden of the drilling operation was carried by Quarrymaster machines and the contractor's experience with them constitutes perhaps the best recommendation they have had to date.

•

CORRECTION

AN editorial in our October issue stated that the new Kelly Shaft of Anaconda Copper Mining Company at Butte, Mont., believed to be one of the world's largest, is 20x9 feet in cross section. The dimensions should have been given as approximately 40x10 feet.

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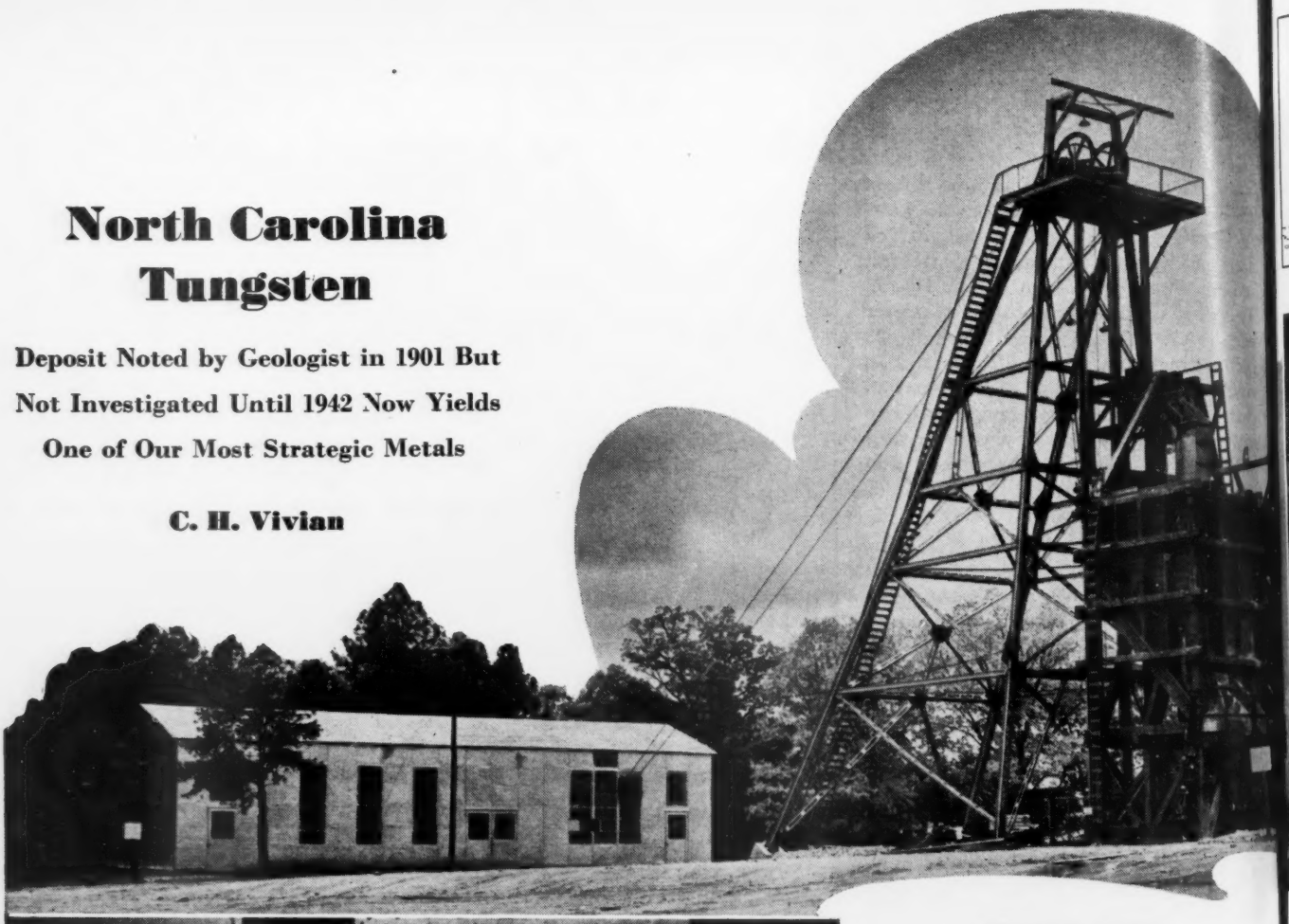
North Carolina Tungsten

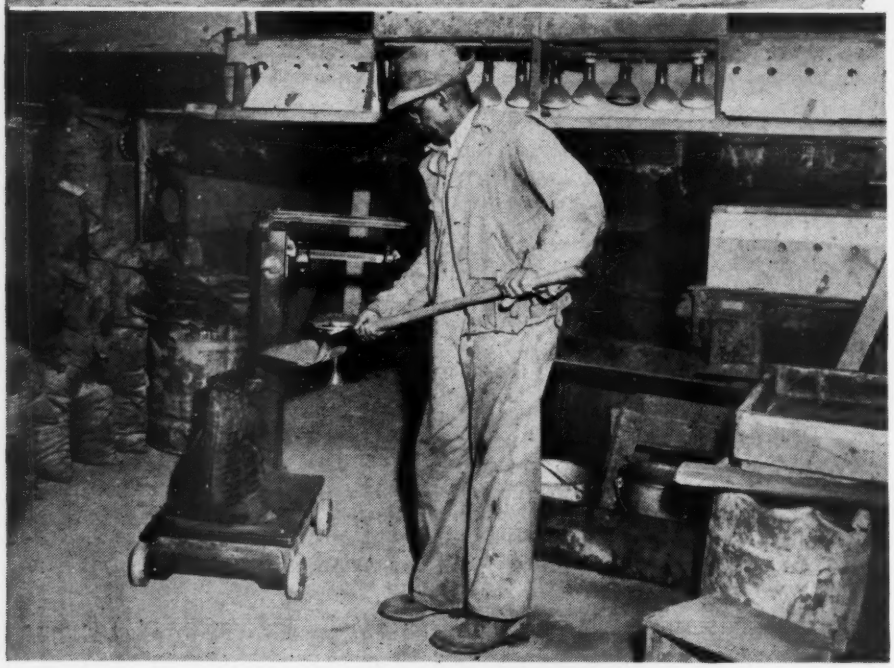
Deposit Noted by Geologist in 1901 But Not Investigated Until 1942 Now Yields One of Our Most Strategic Metals

C. H. Vivian



CENTRAL SHAFT

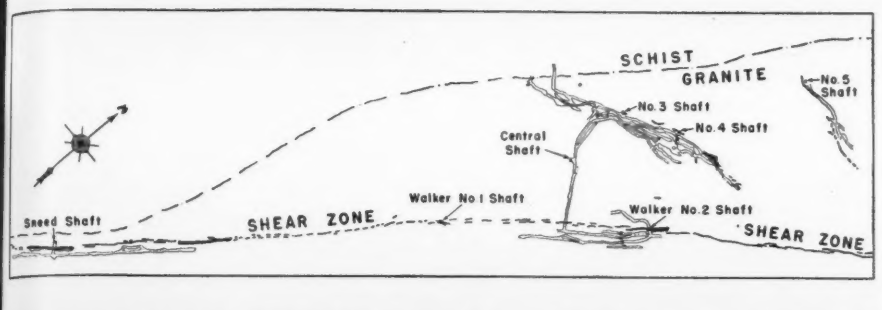
Extending to a depth of 575 feet, this main vertical haulageway is concreted for 40 feet below the surface and timbered with white oak below that point. Its stations on the 300 and 500 levels are approximately 470 feet and 370 feet from the main vein systems on either side. The steel headframe is 85 feet high and is served by a Wellman-Seaman-Morgan 150-hp. electric hoist. The steel and sheet-steel building, the hoist, and the headframe were used at the Mountain City Copper Company's mine near Elko, Nev., until that property was worked out.



SACKING CONCENTRATE

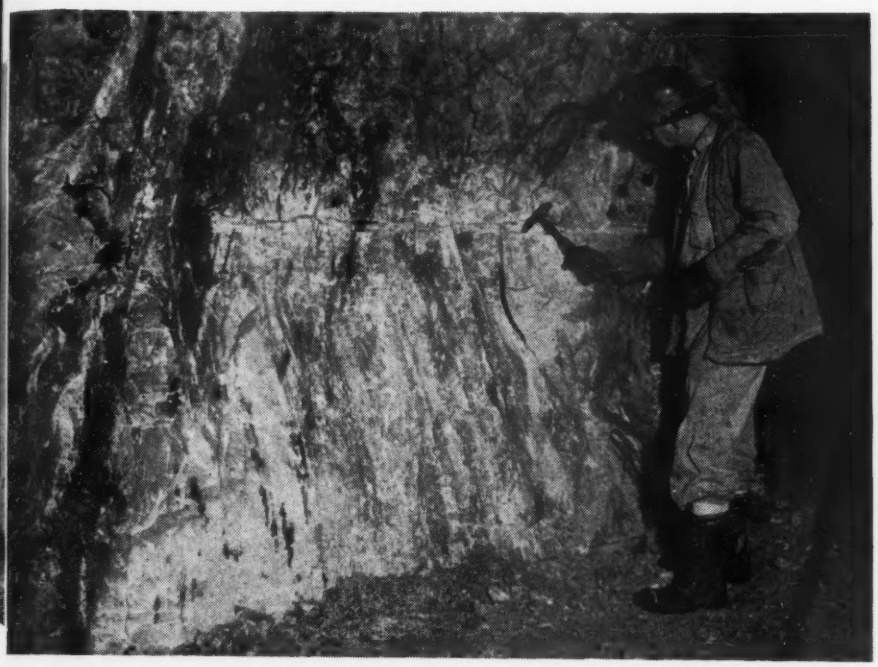
Scheelite, one of the final mill products, is shipped in bags of 100 pounds each to a refinery in New York for upgrading and subsequent sale. Huebnerite, which is of premium grade, is shipped in 400-pound drums to an Ohio plant that processes it into tungsten wire and tungsten carbide.

AN INFORMED and experienced prospector would hardly begin searching for new ore deposits in the eastern part of the United States. Instead, knowing that areas of greatest production are most likely to yield new finds, he would probably try his luck in the western third of the country. Who, for instance, would reasonably expect to discover a worth-while tungsten mine in North Carolina? To begin with, the state is hundreds of miles from any of the previously known commercial tungsten deposits. Moreover, it was pretty well combed by mineral seekers long before the initial gold rush to the West a century ago, and its all-time metallic output is not impressive. Nevertheless, despite the odds against such a thing happening, one of the most important tungsten strikes recorded in the past half-century took place in North Carolina in 1942. Already it has developed into one of the nation's leading sources of this strategic metal, and years of additional underground probing still have to be done before the lateral and vertical limits of its ore bodies can be determined.



AREA UNDER DEVELOPMENT

Mining has thus far been confined to a section approximately 5400 feet long near the center of the 8-mile-long mineralized zone (drawing at left). During the early operations, ore was taken from numerous open pits at various places and shallow shafts were subsequently sunk at six points. To carry mining deeper, Tungsten Mining Corporation sank a central shaft midway between the major vein systems and all ore is now being hoisted through it. Meanwhile, the Sneed shaft is being deepened to the 500 level, which will be connected with the workings served by the Central shaft. Except for the Walker No. 2, which is being used for handling timber and supplies, the other shafts have been abandoned. Double lines indicate underground workings, and solid markings denote igneous intrusions.



HIGH-GRADE ORE

A quartz vein of almost vertical dip on the 300 level that runs above average in tungsten content. The dark streaks, which are seen most plainly at the lower left, are huebnerite. The pick in the hand of A. M. Szynklewski, chief engineer, is resting on one of the drill holes that were put in to blast a development heading through at this location.

The discovery, which has grown into the Hamme Mine, came at a most propitious time, for tungsten headed the list of vital metals that were in short supply in 1942. It was needed, among other things, for fast-cutting machine tools to turn out armament, for radio and other essential communications and electronic apparatus, and for shells that would pierce the heavy armor plate of enemy tanks. It is easy to understand, then, why the Government spurred the development of the prospect, and why it was converted into a producer with almost unprecedented speed. It was fortunately able to contribute importantly to our stock of tungsten during that critical period.

Tungsten is one of those metals that Uncle Sam does not possess in abundance. In ordinary times we import most of our supply, and domestic mines find it hard to operate profitably because the duty on foreign ores and concentrates is insufficient to offset the higher mining cost that prevails here. Through the years we have drawn most of our requirements from China, and during World War II our planes flew many tons of tungsten "over the hump" and thence to ports from which it could be shipped to the United States. In view of our current military junket in Korea, it is interesting to note that Japan obtained most of her needs from that country while she was at war with us. For that matter, we imported nearly $1,000,000 worth of the metal from North Korea in 1949. With China and North Korea in the hands of the Russians, they would, it is estimated, control at least two-thirds of the world's tungsten production. In the face of these facts, the significance of having an additional source of supply such as the North Carolina deposit fall into our lap unexpectedly can be readily appreciated.

There is more than a tinge of romance in the story of how the Hamme Mine came into being. The statement that the discovery was made in 1942 is not strictly true, because Joseph Hyde Pratt of the North Carolina Geological Survey found evidence of the mineralization in 1901 and duly recorded it in one of the survey's economic papers in these words: "Wolframite has been reported as occurring in some quantity on the Cheek farm, near Henderson, Vance County." Except that the prevailing ore is huebnerite (manganese tungstate) instead of wolframite (a mixture of manganese and iron tungstates), he had the matter straight.

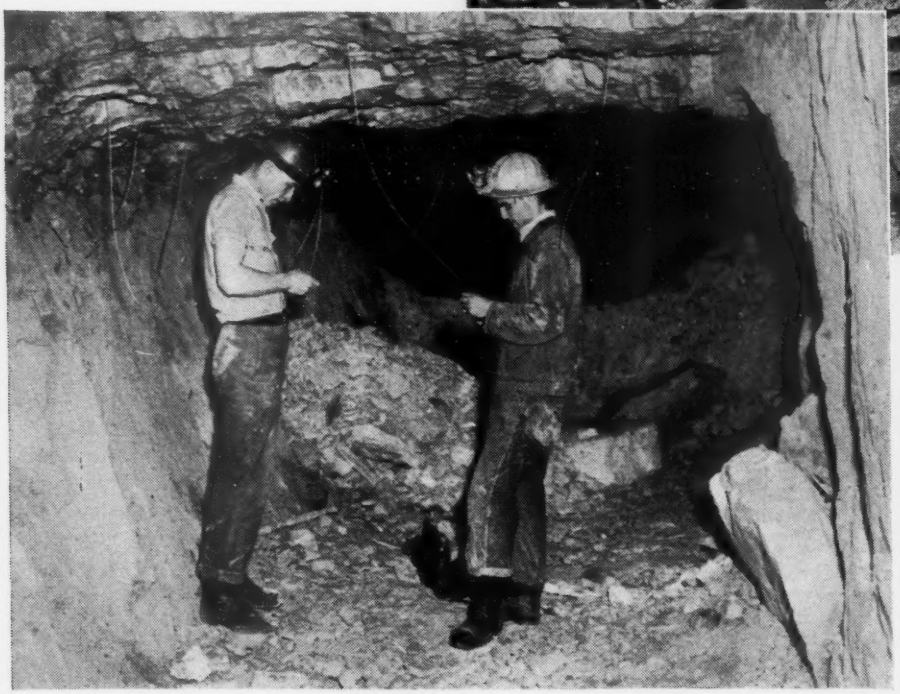
Just why it took 41 years for someone to investigate the occurrence further is not readily apparent, but we can surmise some of the reasons. We have already mentioned one of them: the general impression that the state was comparatively barren of metals. This tended to discourage practical prospectors, but doesn't explain why later-day geologists failed to check Pratt's statement. A second reason was that in 1901 and for some years thereafter tungsten was so little known and in so little demand that few were prompted to hunt for it. Until World War I brought it into the spotlight as an essential component of an alloy tool steel that has the unique and valuable property of holding its cutting edge even while running red hot, it was used principally in making filaments for electric-light bulbs.

In any event, the Vance County huebnerite lay untouched by miners for four decades. Pieces of float—schist or granite with streaks of quartz studded with the cordovan-colored tungstate—were occasionally removed from fields by farmers and made into fences. They were unusual-appearing rocks, to say the least, and their handlers must have noticed that they were very heavy, but none of them was prompted to seek the identity of the peculiar brown mineral. It remained for Richard and Joseph Hamme, brothers, to do this, and they are credited with being the rediscoverers of the outcropping veins. Even they would not have been roaming the hills had it not been for a chain of events brought about by the outbreak of World War II.

The Hamme Brothers had been operating, with varying degrees of success,

UNDERGROUND OPERATIONS

The two miners pictured below are making preparations for blasting in a stope. Broken ore drawn from stopes is trammed to shaft stations and dumped (right) through a grizzly into a storage pocket, from which it is afterward loaded by gravity into skips for hoisting. Two miners are shown at the extreme right driving a development heading in granite on the 300 level with a DA-35 drifter drill mounted on a column and arm. A burn cut round averaging 23 holes is normally drilled. Diamond drills continually prospect for additional ore. The air-operated machine shown at the lower right is drilling an inclined hole 650 feet deep from the 300 level.

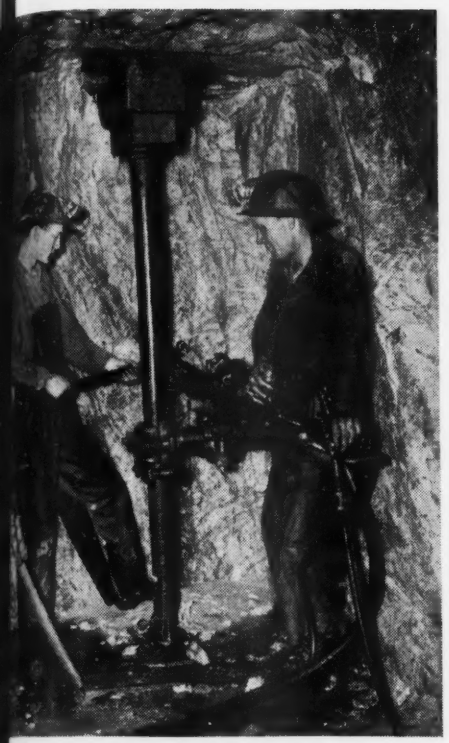


a small gold mine at Virgilina on the Virginia-North Carolina boundary and about 12 miles west of the tungsten deposit. Gold was one metal the Government didn't want during the war, and it frowned upon gold-mining activities and eventually closed down the mines as unessential to the war effort. In the face of this attitude, and with rising costs gnawing away profits, the brothers decided to dispose of their holding. Fortunately, they were able to sell to W.L. Long, vice-president and counsel for Haile Mines, Inc., a concern that came into being in 1935.* Aware of the fact that the Hammes knew minerals and were interested in following mining, Mr. Long suggested that they turn their efforts towards searching for strategic metals that were in short supply. He mentioned two specifically—manganese and sheet mica—but nothing was said about tungsten because no one even dreamed of its presence in the Vance County hills.

With nothing much else to do for the time being, the brothers decided to give Mr. Long's advice a whirl. In tramping around, they came across some of the huebnerite-studded stones in farmers' walls and fences and inquired as to their origin. Further searching revealed some outcrops. Intrigued but baffled by the brownish-black mineral, they sent samples to a younger brother, John, who was studying metallurgy at the University of Utah. Upon learning from him what they had found, they submitted specimens to Dr. Jasper L. Stuckey, North Carolina state geologist, who confirmed the identification. The Hamme brothers quickly acquired control of virtually all the mineralized area and began mining three veins on the Walker property by means of surface pits. To concentrate the ore, they set up in a barn on nearby Little Island Creek a small crude mill consisting of a jaw crusher, two batteries of stamps, and two Wilfley tables. Some of the equipment had been used at their gold mine and was borrowed from the new owner, Mr. Long.

Working in this small way, the Hammes produced and treated 700 tons of ore between September, 1942, and August, 1943. From it they recovered 13,000 pounds of concentrate averaging 70 per-

*Haile Mines, Inc., was organized to take over the Haile gold mine near Kershaw, S.C., that was worked prior to the Civil War and is one of the oldest gold properties in the country. It was there that a German engineer named Theis developed the barrel chlorination process for extracting gold from its ore. That was about the first chemical gold-recovery technique to be applied, and was used until replaced by cyanidation. The mine was closed down many years before the new company reopened it. Haile Mines, Inc., operated it from 1935 to 1942, when all domestic gold-mining activities were suspended by the Federal Government.



cent tungsten trioxide. Meanwhile, the Government had become interested in the deposits and, through the Bureau of Mines and the Geological Survey, began mapping the district and conducting a trenching and diamond-drilling program to gain an idea of its extent. This work was started in June, 1943, and the early findings were so favorable that pressure was brought to bear on the owners to increase the output. Not being in a position to expand quickly, the Hamme brothers turned the property over to Haile Mines, Inc., under terms that gave them a royalty interest in all production.

Upon taking over in August, 1943, Haile Mines installed additional equipment and introduced planned underground methods in place of the haphazard open-pit potholing practices that had prevailed. Experienced men were hired from the mica-feldspar mining district around Spruce Pine, N. C., and the copper-producing section at Copper Hill, Tenn. Shafts were sunk, drifting on the veins started, and work was begun on a mill designed to process 200 tons of ore a day. During this period the Government was urgently pushing for production and granting the highest priorities for necessary materials and equipment. From August to December the new operators mined and milled 2797 tons of ore that yielded 60,501 pounds of concentrates having an average tungsten-trioxide content of approximately 70 percent.

Then conditions suddenly changed. The War Production Board decided that tungsten stocks had been built up sufficiently to see the emergency through and abruptly dropped the metal from first to fourteenth place on the list of strategic materials. One reason for the easing of the shortage was that the Yellow Pine Mine in Idaho came into production about that time. With its program of expansion just getting well underway, Haile Mines found its high priorities withdrawn, but it continued as best it could under that handicap. The situation remained the same throughout 1944, but in March, 1945, the Government discovered that its tungsten reserves were getting low again and once more began putting on the heat for greater output and offering top priorities for anything that was needed to speed up operations.

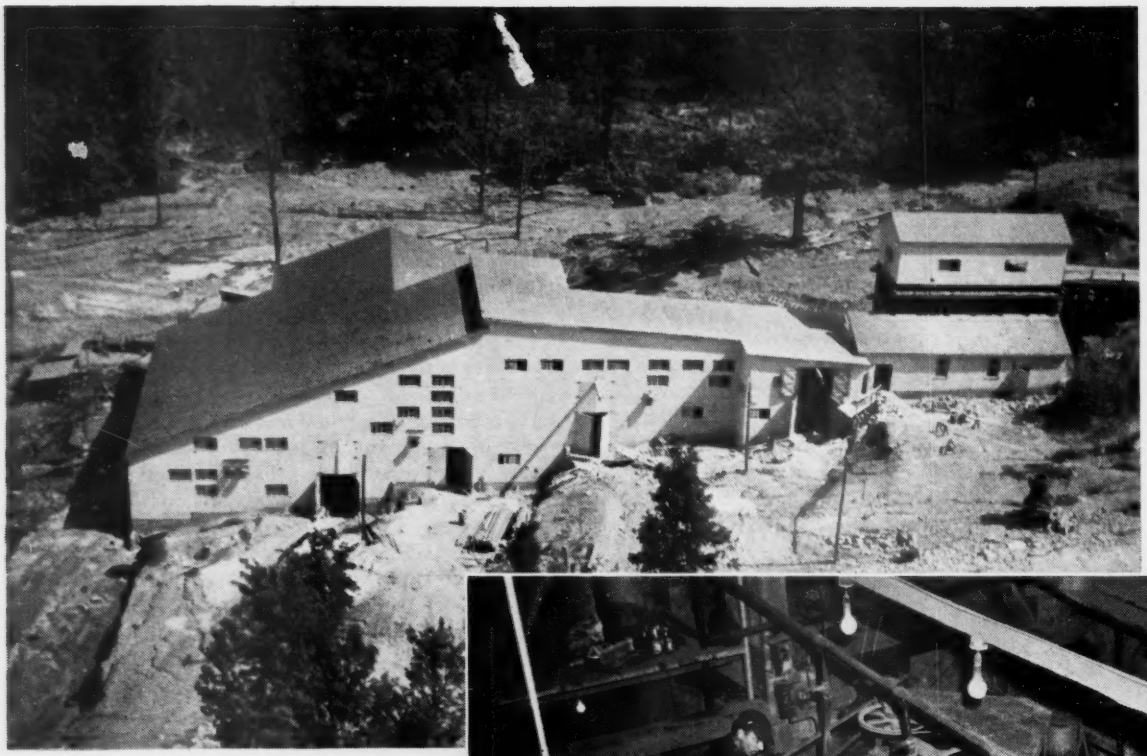
Haile Mines was willing to go all out, but did not have the funds to carry out the desired program. Knowing that General Electric Company had been acquiring and developing mines in an effort to assure itself a continuing supply of tungsten for incandescent lamps and other purposes during the uncertain war period, President H.S. West of Haile Mines appealed to G-E for help. By that time the North Carolina deposits had been opened up sufficiently to leave no doubt that they were among the most important yet found in the nation. After its engineers had examined them, General Electric joined with Haile Mines in forming a new company, Tungsten Mining Corporation, which has since then operated the Hamme Mine. In return for tungsten properties in Arizona and Idaho and for $450,000 advanced as working capital, General Electric received 30 percent of the shares while Haile Mines owns the remaining 70 percent.

With adequate funds thus provided for expansion, Tungsten Mining Corporation vigorously prosecuted development of the mine during the remainder of the war and has continued at an unabated pace ever since despite wide fluctuations in the price of tungsten. The basis upon which the metal is sold is peculiar. It is priced not by the pound but by the unit, a unit being 1 percent of a ton or 20 pounds of contained tungsten trioxide. Regardless of the mineral in which it occurs, the element is always found as trioxide and never as the metal itself. Since comparatively rich ores have a trioxide content of only around 1 percent, all must be concentrated to upgrade them. The commercial grade of concentrate normally contains about 60 percent of trioxide, and a higher grade commands a premium.

During World War I, when the Germans first demonstrated the vital role tungsten tool steel plays in speeding up the machining of steel, the price soared to more than $100 a unit. With the conflict ended, it plummeted, and domestic mines either curtailed or stopped production. In the early part of 1939, the year World War II began, purchases were made for as low as $12 a unit. In September of that year the price reached $25 and then dropped slightly. The wartime peak was around $33, but when fighting ceased it soon sagged and was approximately $17-19 last spring. With the outbreak of trouble in Korea it shot up immediately, and is now about $39. The import duty on tungsten ores and concentrates coming into the United States was reduced by executive order of President Truman in June, 1948, from 50 cents per pound of contained metal (equivalent to $7.93 a short-ton unit) to 38 cents per pound ($6.03 per unit). On October 12 of this year it was restored to its former level, effective December 11, 1950.

The North Carolina tungsten district is 18 miles north of Henderson, and the seat of current operations is 3½ miles northwest of the village of Townsville. The country is a rolling one and moderate in relief, with elevations ranging from 250 to a little more than 400 feet. The mineralized zone trends northeast-southwest, is about 8 miles long, and up to 3 miles wide. Its northern end crosses the state line into Mecklenburg County, Va., but development work has thus far been confined to North Carolina.

Granite and schist of several varieties are the predominating country rocks, and the line of contact passes in a general north-south direction through the area being mined, with schist to the west and granite to the east. A shear zone, in which the rocks have been broken up and more or less sheeted by repeated vertical movement along a fault plane, has a more easterly trend than the contact. Many of the best veins are in this

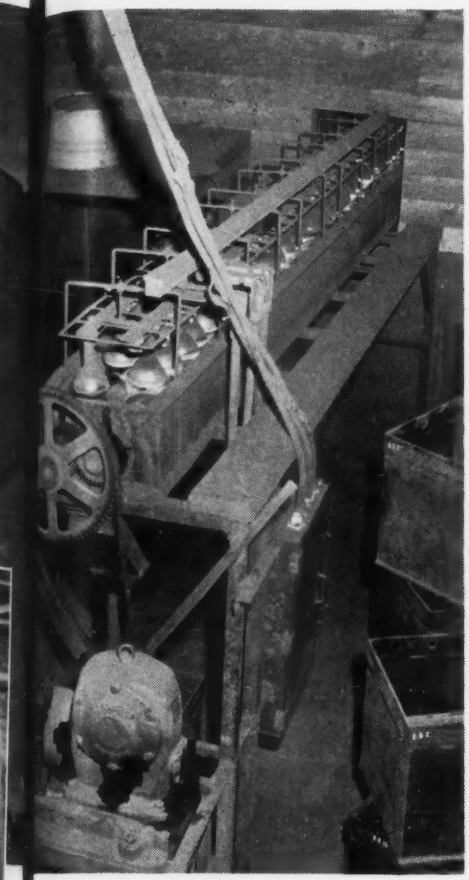


GLIMPSES OF THE MILL

The 300-ton mill (above) is built on a hill side to take advantage of gravity flow wherever possible. Following crushing, initial separation of the ore and gangue is effected in jigs. Tailings are further reduced in size and then run over one of nine wet, oscillating gravity-concentration tables such as that shown in the bottom picture. Table concentrates are treated in a 4-cell flotation machine (right) for removal of sulphides. Concentrates are dried in one hour by conveying them slowly under a battery of forty-four 375-watt infrared lamps (upper right).

zone, but others are in the granite and along the schist-granite contact. The latter are more erratic, and mineralization is spottier. Dikes of diabase of north-south trend, some several hundred feet wide, cut the veins and the enclosing rocks at a number of points. Diorite-like intrusions also occur in several places, and some aplite is present.

Veins, which carry their greatest values in the central sections, have an average width of 5-10 feet, but occasionally reach 30 feet. They dip steeply as a rule, generally from 50 percent to vertical. They are not straight-walled, but pinch, swell, and split, and the ore bodies are consequently somewhat lenticular in shape. Distinct sheeting, with the mineral bands tending to parallel the vein walls, is characteristic. Maximum lengths of 300 feet are fairly common, and in a few instances they reach 600 feet.



In the developed area mineralization is heaviest in two strips that form a narrow V, with the point towards the north. One branch has been designated the No. 2 vein system and the other the No. 3. In their early operations, the Hammes first trenched along outcrops that came to or near the surface, then dug pits and finally shafts. The latter were deepened by their successors. Four of them were carried to depths of from 100 to 300 feet and workings opened up from them on one or more levels. This mining method sufficed to open up numerous sources of ore during the war period but was a makeshift at best.

With the conflict ended, Tungsten Mining Corporation began to plan a more systematic operation and to equip the property for long-time, economic production. Sinking of a new central shaft between the two principal vein systems was begun in 1948 and completed in 1949. To the bottom of the sump it is 575 feet deep, and its cross section of 15 feet 10 inches by 6 feet 4 inches is divided into three compartments: two for transporting ore, materials, and men, and one to carry air, water, and electric lines. Levels that have now become haulage horizons were established at 300 and 500 feet and crosscuts driven east and west to the ore bodies.

During recent months the Sneed Shaft, the southernmost one of those previously used, was deepened from 225 feet to the 500 level of the central shaft. All the other old shafts, except No. 2 towards the northern end of the area being worked, have been abandoned. It is being retained for handling timber and supplies. Practically all the ore is now being hoisted through the Central shaft, but the Sneed will increase production when it has been equipped to the 500 level and that level has been developed.

In addition to the major tungsten mineral, huebnerite, some scheelite (calcium tungstate) occurs. It averages around 8 percent of the ore mined. Although solid blotches of huebnerite are the rule, some of the crystals have been torn apart by underground movement and recemented with quartz. Most of the scheelite, apparently formed by alteration of huebnerite, exists as a film ranging in color from white to brown. The remainder, believed to be of primary origin, varies from white to cream and is sometimes massive in structure. Gangue minerals consist chiefly of quartz, fluorite, and sericite, with some chalcopyrite, sphalerite, tetrahedrite, galena, pyrite, rhodocrosite, and a bismuth-bearing galena.

Stopes average 10-12 feet in width, but reach a maximum of 40 feet. Where the walls stand well, shrinkage stoping is practiced, but there is generally some ore dilution from rock caving and spalling. For the most part, however, square-set stopes prevail. Timber sets used there and elsewhere are principally of red oak, which is obtained from sawmills within a 15-mile radius for $45 per thousand board feet. This wood weighs about 64 pounds per cubic foot, the same as water. Consumption averages 100,000 board feet monthly. The pieces are delivered cut to 8x8-inch and 6x8-inch sizes, and their ends are framed in the mine carpenter shop. White oak for shaft sets is soaked for from 48 hours to a week in copper naphthenate to lessen rotting. Oak that has been underground for some time gives off a distinctive odor.

Drilling is done with Ingersoll-Rand machines: R-58 stopers in stopes, DA-35 drifters in development headings, and J-50 Jackhamers in shaft work. Detachable steel bits were used until May, 1947, when they were replaced by the Carset type. This seems entirely appropriate inasmuch as some of the tungsten they help to produce goes to the Carboloy Company in Detroit for processing into the tungsten-carbide inserts that make these bits fast-cutting and long-lasting. A conventional steel bit was good for only 12-18 inches of hole before it required resharpening, and frequent changes were necessary. In sharp contrast, Carset bits drill an average of 124 feet before needing attention. In stopes they are good for around 70-80 feet; but in development headings, which are mostly in granite and vein quartz, they exceed that footage sufficiently to bring the average up to the figure given. During the first eight months of this year, 1851 of these bits drilled 229,535 feet.

The bits are 1½-inch Series 13 (1 3/16-inch stud attachment) and are used on alloy-steel drill rods. Miners are issued new or resharpened bits as they go on shift. They return them to the surface when they are through work, and the man who attends to the miners' lamps also dresses the bits at night on a Jackbit grinder equipped with a Carborundum wheel. The number issued depends upon where they are to be utilized, but equals two complete sets plus one spare. Development work in granite or vein quartz, where three rod changes are made to drill a 6-foot hole, calls for seven bits. In stopes, where five changes are needed to put in a 10-foot hole, each drill runner gets eleven bits.

Blasting in stopes is done with du Pont explosives detonated with du Pont millisecond electric blasting caps, which greatly reduce the interval between sequential shots as compared with conventional delay primers. Their adoption has permitted the use of one less stick of powder per hole and has resulted in better fragmentation of the rock and ore with consequent easier and cheaper handling. Dynamite of 40-percent strength is used in stopes, and also predominates in development headings where some of 60 percent is added.

In stopes that gain lateral extent between levels and are not served by chutes at their extremities, the ore is moved to the nearest chute or open stope by scrapers powered by Ingersoll-Rand hoists. Most loading, however, is done directly through chutes. Three mechanical mucking machines handle broken material at development headings, but when this equipment is not available the operation is performed by hand An interesting departure in mucking equipment ordinarily employed in metal mines is noted here. Although No. 5 scoop shovels serve to a limited extent, most miners load with short-handled forks having eleven prongs. These forks are used exclusively for handling feldspar in the mines of the Spruce Pine district, and the miners who were recruited from there to get the Hamme Mine going insisted on having them, so the management provided them. Since then, many miners have been trained from among the surrounding country folk and they, too, have taken largely to the forks.

Ore or waste rock, as the case may be, is loaded into 16-18 cubic-foot steel cars made by C.S. Card Iron Works in Denver, Colo., and hauled by Mancha storage-battery locomotives (mules) to the shaft station. There the cars dump onto a grizzly made up of inverted railroad rails spaced generally 11 inches apart. Pieces too large to go through are broken with hand-wielded hammers. The material falls into a large storage pocket excavated from the rock beneath the haulage level and divided into two compartments, one for ore and the other for

waste. Material can be dropped from either side through a manually controlled arc gate into a measuring pocket. From the latter it is discharged into a hoisting skip through a vertical gate controlled by an air cylinder. The loading points are 50 and 75 feet below the 500 and 300 haulage levels, respectively.

The 150-hp. hoist on the surface can transport 375 tons in two operating shifts. Arriving above ground, the material is dumped into an elevated bin having separate compartments for ore and waste. The skipman directs it to the proper side by manipulating a locally designed deflector plate that is popularly known as the "flip-flop." The material is drawn from the bin into either of two Federal trucks that haul ore to the mill and waste to nearby disposal areas.

The projected mining program calls for breaking and hoisting sufficient ore to maintain production at around 60,000 units of 60-percent concentrate annually, and development work has been stepped up to meet this objective. During the twelve months ended last June, 4339 linear feet of underground passages were driven to give access to known ore bodies, and the total will be greater in the coming year. At the same time, diamond drilling has been accelerated to explore the limits of known deposits and to prospect for additional ones. It totaled 8483 feet of hole for the year ended July 1, during most of which only one drill was in use. Now two drills are being operated—one on the surface and one underground—and monthly footage is running around 1200-1500.

Most of the holes that are started underground are directed slightly upward from the horizontal to probe for deposits within the 500-foot vertical section that has been opened for mining. The deepest of the down holes have reached only 100 feet below existing workings. Some of them have penetrated ore, and so far, for all practical purposes, there is as yet no bottom in sight for the mine and all geological information available indicates that the deposits persist to depths considerably below the present lowest workings.

With only about one-eighth of the length of the mineralized zone opened up, and not all of that carefully investigated, the management is presently as much concerned with lateral as with vertical exploration. The aim is to pace development and prospecting operations so as to maintain ore reserves equal to three years of scheduled output. Underground workings are now more than 5 miles long. Production is coming from all levels—from 100 to 500—and in some instances single ore bodies extend from the surface to the 500 level, with their lower limits still unknown.

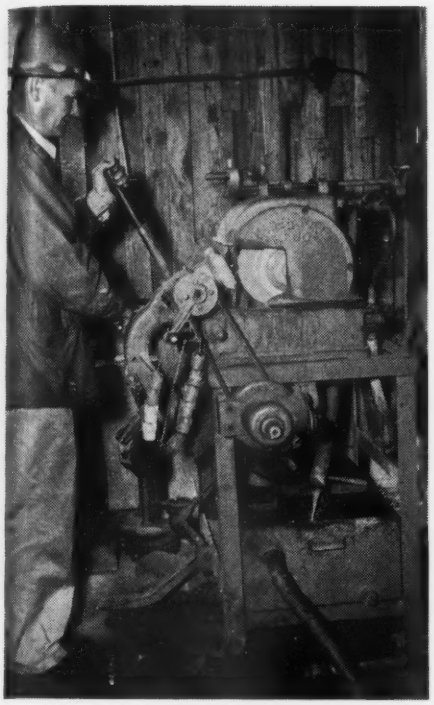
Construction of a new mill of 200 tons daily capacity was begun in 1946, but because machinery was still hard to get some compromises that affected efficiency had to be made. As soon as additional equipment could be obtained the capacity was increased to 300 tons daily, and gradual improvements in the flow sheet have been brought about since then. As the mill stands today, it sometimes handles up to 320 tons in 24 hours. Mill feed averages around 0.9 percent in tungsten-trioxide content, and of this 85-88 percent is recovered.

The milling process is a combination of jigging and wet tabling supplemented by flotation, and the yield of tungsten trioxide is about equally divided between them. After two crushings to reduce the ore to minus ½-inch size it is screened, and that under ⅛-inch goes to jigs which produce a heavy concentrate and tailings. The tailings are further reduced in size in a rod mill and then classified into nine sizes that range from sand through fine sand to slimes. This fine material is distributed among nine tables which yield concentrate, middlings, and tailings. The middlings are recirculated over tables, being reground if necessary. The concentrate is further treated in a 4-cell Denver Sub A flotation machine which does not increase tungsten recovery but upgrades the concentrate by removing sulphides.

The jig and table-flotation concentrates are dried separately by infrared lamps and then combined to form a single concentrate that is divided into two sizes by a small screening and crushing plant. These products are run over a Dings high-intensity, six cross-belt type

EARLY WORKINGS AND SNEED SHAFT

These pictures show open pits from which ore was extracted when the deposit was first opened. In the background of the view at the right is the Sneed shaft, which has just been deepened from 225 feet to the 500 level of the Central shaft and is being made ready for use in hoisting ore. It is equipped with a 65-foot wooden headframe and a Vulcan 75-hp. hoist. Ore hoisted there will be trucked half a mile to the mill.



SHARPENING CARSET BITS

Carset bits have been used for all drilling since 1947 and they average around 125 feet of hole each before being discarded. When drill runners go on shift each is given his allotted number of bits strung on a wire carrier (one is shown near the center of the picture). Used bits are resharpened with a Carborundum wheel on an Ingersoll-Rand JBD grinder as demonstrated above by James Goodman, master mechanic at the mine.

about 15 ounces of silver and 2-3 percent of lead and zinc. More than 1000 tons of these tailings have accumulated, and it is possible that they may be profitably treated at some later time.

Because of the importance of the North Carolina deposit to the national economy, special provisions are being made to prevent inundation of some of the northern section by water that will be impounded by Buggs Island Dam now under construction by U.S. Army Engineers on the Roanoke River and some 12 air miles to the northeast. As originally planned, with the reservoir full, the water would be backed up in a side valley to a height equivalent to the 320-foot contour, mean sea level. To estimate how much ore might be rendered unrecoverable through possible flooding, the Government did extensive trenching and diamond drilling in 1947-48. The conclusion reached was that the quantity of ore in place in the affected area is sufficient to warrant taking special measures to prevent encroachment. To do this, it was decided to construct a supplementary dam in the side valley to stop the flow at a line about 2 miles from the central shaft, and work on it is now in progress. Surface water that runs down the valley and is impounded behind the dam on the mine side will be pumped over the structure into the reservoir.

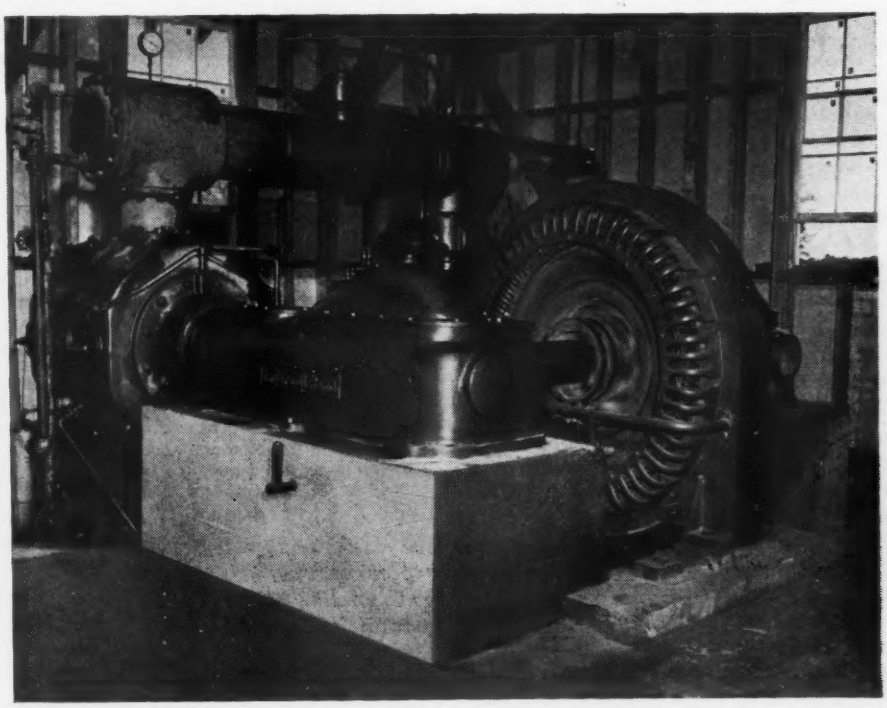
Electricity for mining and milling operations is purchased from a public utility and is brought in over high-tension lines. Compressed air is supplied by two Ingersoll-Rand 200-hp. synchronous motor-driven compressors that discharge at 100 psi. pressure, and a 75-hp. I-R machine provides reserve capacity. Water for the mine and mill and for fire protection is pumped from a nearby creek into two elevated tanks from which it is delivered to points of use by gravity. A third tank stores drinking water, which comes from two 150-foot wells.

To provide low-rental housing for its employees the company built 50 one-family houses including seven for staff members, five duplex houses, and a bunkhouse for single men. It also maintains a dining room for staff members and unmarried miners. A dirt road that skirts the mine headquarters was blacktopped by the state to improve transportation facilities. The latest recognition of the importance of the mine was the establishment of a post office designated as Tungsten, N.C.

Tungsten Mining Corporation has its principal office in New York City, where President West makes his headquarters. Mr. Long, vice-president and counsel, lives in Warrenton, N.C., and spends considerable time at the nearby mine. The resident personnel is headed by J.R. Sweet, general manager. A.M. Szynklewski is chief engineer; R.M. Richmond, mine superintendent; and J.V. Hamme, mill superintendent. Mr. Hamme is the brother to whom the discoverers of the deposit sent samples for identification while he was attending college.

magnetic separator to segregate the slightly magnetic huebnerite and the nonmagnetic scheelite. The two sizes of huebnerite from the separator are, in turn, combined, the resultant high-grade concentrate assaying from 72 to 74 percent tungsten trioxide and commanding a premium. It is normally shipped to the Cleveland Wire Works, Euclid, Ohio, where it is refined and made into tungsten powder and wire. Much of it is ultimately used in the form of tungsten carbide for cutting tools or of tungsten wire for lamp filaments and other purposes. For these applications, it is essential that the concentrate be relatively free of certain contaminants, especially molybdenum and sulphur, and the product meets these specifications. The scheelite obtained from the magnetic separator is of low grade—25 to 35 percent tungsten trioxide. It is transported to the Wah Chang Corporation at Glen Cove, N Y., for upgrading. Tungsten Mining Corporation pays the treatment charges and markets the final product.

Tailings from the tables and flotation machine are run to separate impounding areas. Those from the tables run about 80 percent quartz; those from the flotation machine carry most of the sulphides contained in the original ore, as well as



PART OF AIR-SUPPLY PLANT

This synchronous-motor-driven XRE compressor that delivers 500 cfm of air furnishes approximately half of the compressed air utilized for operating rock drills, gates on underground skip-loading pockets, etc. A duplicate machine is installed at another location and a third unit of smaller size is available for peak-load or standby service.

New Drain for the Rimrose

Political Complications and War Delayed British Project for Many Years

A. M. Brodine

SEA-OUTFALL COFFERDAM

This structure was built of Larssen No. 3 steel sheet piling averaging 50 feet in length and driven by a McKiernan-Terry double-acting steam hammer. For handling piles as well as muck during excavating, a 5-ton electric derrick with a 120-foot jib (pictured above) was mounted high enough on concrete piers to keep the cab clear of storm waves. The cofferdam was designed to withstand the impact of heavy seas that reach a height of 10 feet. The upper level of the structure was fixed at 32 tide gauge, the highest expected in calm weather being 31.5. No attempt was made to exclude waves above that point, but sluice valves were provided at the offshore end for drainage. The picture above and the one at the top-left show the difference between the water level at half and high tides.

FOR many years the residential suburbs just north of Liverpool, England, were faced with the problem of insufficient drainage. The Rimrose Brook outfall was the only sewer outlet available for carrying off the waters from an area of approximately 700 acres, as well as from the brook itself. It was altogether inadequate for the job it was called upon to do. The region was inundated periodically. Aside from the aftermath of smells and filth, hundreds of families were trapped in their homes and furniture and premises were damaged.

In 1918 floodwaters reached a depth of 9 feet in one of the main streets of the Borough of Bootle, an independent municipality of some 80,000 inhabitants. First official action to cope with the situation was taken on October 6, 1926, when the Bootle Council instructed the borough engineer to submit a report on the cause of the floods and their prevention. Following that step, the mayor of the community called a conference of representatives of the suburban towns of Waterloo, Seaforth, Litherland, and Sefton, all in the affected area, to formulate plans by which the problem could be studied in its entirety.

In 1927 serious flooding was experienced on eleven occasions. Despite the gravity of the situation, little progress was made until 1931 when Sir George Etherton, then clerk of the Lancashire County Council, managed to bring about agreement among the districts in the matter of appointing a consulting engineer to prepare a drainage scheme for the area. The latter's first report was issued in October of 1932. Meanwhile, high water continued to be a menace. During June, 1933, although a time of low tides, floods in Bootle reached the unprecedented depth of 9 feet 8 inches, and a cyclist, trapped in currents and whirlpools in one of its streets, was drowned.

In August, 1933, the engineer made a report, and at that time the cost of the

U-SHAPED SECTIONS IN OPEN TRENCHES

The view above shows the junction of two U-shaped sewers. The one on the left is 8x7¼ feet in size and the other 5½ feet. Throughout the contract they vary in dimensions from 5x4½ feet to 10x9 feet. Below the spring line they are lined with special brick and above that point with reinforced concrete.

ROUTE OF LINE

Rimrose Brook, the capacity of which was more than overtaxed during flood times and which was unsatisfactory from a sanitary standpoint for carrying sewage, will be filled in upon completion of the entire drainage scheme. The section described in our article is shown on this plan drawing.

proposed project was estimated at $1,136,460 (£282,000).* Naturally, the preliminary plans were amended several times, and in their revised form were submitted in July and September of 1934 and again in September and November of 1937. Meanwhile the local authorities held many meetings and conferences, formal and informal, to consider all aspects of the scheme, including the proportionate share of the costs to be borne by each.

Because of the different interests involved and the diverse opinions of the representatives it was not easy to reach agreement in these matters. Looking back on those early days, the board members recall the late Earl of Derby—a life-long public servant—working behind the scenes, and give him credit for bringing the opposing factions together. It is said to have been largely through his efforts that a joint committee representing all the communities concerned was set up on February 5, 1937, with central authority to carry out the undertaking.

By that time the estimated cost had risen to $1,680,510 (£417,000), the increase being partly due to changes in plans made necessary by development work, both completed and contemplated, for the purpose of providing more room for housebuilding in Bootle and Litherland. On March 16 the consulting engineer was instructed to proceed with surveys and drawings. The original proposal included the construction of a sewage-treatment plant, but that was abandoned when the Department of Scientific and Industrial Research, after investigation of the discharge of crude sewage into the River Mersey, reported that it had no appreciable effect on the amount and hardness of the deposit in the estuary. Thus $217,620 (£54,000) was shaved from the budget (based on 1933 prices) and helped to offset the steadily rising costs. On June 28, 1938, the committee in charge approved plans and estimates in the amount of £417,000.

Although twelve years had elapsed since the initial step towards flood control was taken by the Bootle Council, the letting of a contract still had to await a public inquiry called in September of 1938 to determine the effects of the drainage system on public health. Not until that endorsement was forthcoming did the British Ministry of Health approve the scheme in full in February, 1939, and on July 11 the joint committee accepted a bid for the construction of the first part of the system. Then, before the contract could be entered into, World War II began.

Under the Bootle Corporation Act of 1939, the joint committee was superseded by a joint board representing the five county and borough councils involved. Even during the conflict, although construction could not proceed, the board remained active so that the drainage project could be started at the earliest possible date. In April, 1942, it appealed to local Members of Parliament to take the necessary steps that would give the undertaking top priority when public works could again be carried out.

So it was that the Rimrose Brook Drainage Scheme, which had begun as a fairly uncomplicated town project, branched out to include first the neighboring communities and eventually the national government. Where there had been boards, councils, committees, aldermen, and clerks, now there were bureaus, agencies, ministries, ministers, and Members of Parliament to deal with. As a result, the plans soon underwent other, more fundamental changes.

For the first twenty years the dominant idea of the local authorities had been flood control. World War II and postwar considerations of national welfare changed all that. Houses were urgently needed in England, and the main objective of the Government Priority Organization in approving the Rimrose Brook main trunk sewer in June, 1945, was to make undeveloped lands in the

*All monetary figures quoted are based on an exchange rate of $4.03 per pound current at the time the estimates were made.

watershed area available for building purposes. The new outfall would, of course, offer considerable flood relief, but the latter phase of the drainage system was to be undertaken at a later date. The action of the Priority Organization thus enabled the board to obtain the necessary materials and supplies to start operations.

In August the documents and specifications for the initial part of the project were sent to the government printing office. There again, obstacles that had dogged the board all along once more interfered with getting things done. Owing to the unusual conditions existing in England immediately after the war, it took the printers seven months to complete the job! Finally, on March 26, 1946, the contract was awarded to The Norwest Construction Company Ltd. of Liverpool on its bid of $2,830,568.73 (£702,374 7s. 7d.). Later, the board agreed to pay an additional sum not exceeding $201,500 (£50,000) for any steel sheet piling and well-pointing that might be needed over and above that already provided for. On August 12 the contractor was notified to go ahead. His work included, roughly, five types of construction: 1, A sea outfall built within a cofferdam; 2, brick-lined precast-concrete segmental ring tunnels; 3, sewers built *in situ* and concrete pipe sewers in tunnels; 4, U-shaped sewers in open trenches; 5, concrete tube sewers in open cuts.

Though time was a vital factor, it wasn't long before both the board and the contractor found themselves on a materials merry-go-round. The 1946 fuel shortage had reduced the already scarce supplies of steel and cement, and the lack of timber created a great deal of difficulty. Even high-grade material from the forests of Canada and the United States, and other expedients such as the use of unsuitable lengths, did not always fill the gap. A few figures may serve to give an idea of the scope of Contract No. 1, which called for 86,000 cubic feet of timber, 10,850 tons of cement, 50,500 tons of aggregates and 23,100 tons of sand for concrete, 2,031,000 bricks, 550 tons of steel reinforcing bars, and 780 tons of steel sheet piling.

UNDERCROSSING A RAILWAY

At one point where the line passes under railroad tracks, the original plan called for an 8-foot-diameter tunnel lined with precast concrete, but digging disclosed unstable ground below the invert level. Instead, a rectangular sewer approximately 7x11 feet in section was constructed in a cofferdam of steel sheet piling driven to a clay bed underlying water-logged peat. Through the use of welded steel framing, the piling served both to prevent caving of the sides of the excavation and as a permanent support for the sewer. To avoid disrupting service on the busy suburban electric railway, much of the work was done at night and week ends in close coöperation with the road's engineers.

PRECAST-CONCRETE RINGS

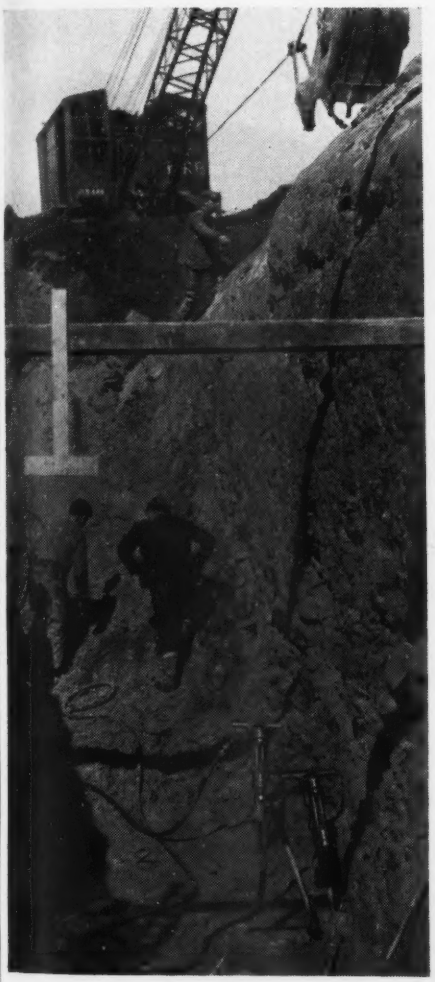
Brick-lined, precast-concrete segmental rings up to 12 feet in external diameter, like the one shown here, were used in building the larger underground sections of the sewerage system. Although this type of construction calls for skilled tunneling crews, it requires relatively little timber and cement, which was an important consideration in the case of this contract.

The construction program was scheduled to reach its maximum stride in March of 1947 with a weekly peak delivery of 300 tons of cement. From that month on through June, however, the weekly average had trickled to 52 tons, and by August it had risen to only 65 tons. As a result, operations on five of the seven sections were almost at a standstill, with only one-third of the men on the job efficiently employed. The contractor, unable to proceed at contract speed, had to close down some of the work.

At that time the project's board chairman was the Member of Parliament for Kirkdale, and, supported by his local colleagues in Parliament, he met with ministers and ministries in an effort to clear the way for the badly needed materials. How successful they were can be judged by the fact that by May, following, cement deliveries had risen to 850 tons a month. From then on progress was rapid and all major work on the main trunk sewer was completed within twelve months.

The cofferdam for the building of the

sea outfall was carried far enough into the estuary so that the discharge would at no time be exposed above water even at low tide. It was of sturdy design because there was the possibility that it might have to remain in position for at least a year, during which period it would in all probability be battered by waves 10 feet high and with a force of one ton per square foot. Two lines of steel sheet piling were driven, and to resist those blows they were braced by a system of internal steel members welded to the piling so as to leave a clear space for the construction of the sewer once excavating was finished. As expected, several violent storms occurred, but the cofferdam sustained no damage. Eventually, the steel piling was cut off above the permanent structure and left in place.



TRENCH WORK

Rock encountered in certain open-cut sections was removed by the aid of air-operated Jackhamers and paving breakers. Two of the latter are shown in the picture above and were used for trimming. Where ground conditions favored, blast holes were put down with a DA-35 wagon drill. Air for these machines was supplied by Ingersoll-Rand diesel-driven portable compressors. At the right is a section of 36-inch-diameter concrete-tube sewer in open country. Note the dewatering system on the right bank. Ground-water level in the area is normally 4 feet below the surface.

At the inshore end of the cofferdam it was necessary to cut two parallel trenches, each wide enough to accommodate a row of piling, through a sloping seawall faced with large stone blocks. This was done by CC-45 paving breakers and JA-40 Jackhamers powered by Ingersoll-Rand Model 105 portable compressors, which were among the first tools and equipment on the job. Storm conditions at that point in the River Mersey are such that it was considered inadvisable to open large areas in the wall at one time because, with such breaches made, ensuing rough weather might cause extensive damage.

Therefore, as soon as the trenches had been cut, the piling was driven and all gaps in the breakwater were immediately filled with concrete. After the remainder of the blocks between the lines of piles had been removed by drilling and light blasting, the cofferdam area was excavated by aid of a derrick crane dumping into a large hopper on shore. From there the spoil was transported by dump trucks to a point 5 miles distant, where it was deposited on land being fortified against the erosive action of the tides.

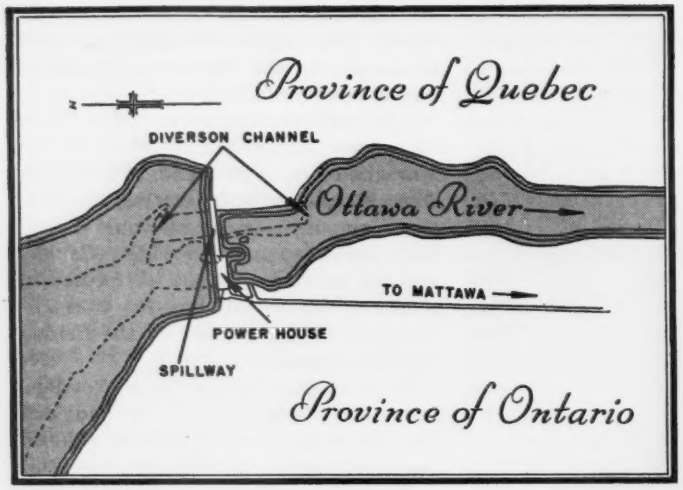
The new outfall is made up of precast segmental rings of reinforced concrete backed with mass concrete and lined with special brick, a type of construction that is gaining favor in England as a substitute for the familiar cast-iron lining. Though the work of placing the rings requires skill, the contractor reports that good progress can be made with sewers more than 6 feet in diameter once properly balanced tunnel crews have been organized.

Tunnels driven on the contract differed in type and size, ranging from headings for 30-inch-diameter concrete tube sewers to 12-foot sections lined with the precast-concrete rings just mentioned. The smaller working faces were advanced by the use of air-operated spades where hard clay was encountered and by explosives in rock. Blast holes 1½ inches in diameter were drilled throughout to take standard 1¼-inch Polar Ammon gelignite cartridges. Norwest Company's engineers would like to have tried tungsten-carbide (Carset) Jackbits on some of the rock formation penetrated on the job, but they were unable to do so on account of the British currency position.

Work on the U-shaped sewer sections in open trenches proceeded without difficulty in open country, but necessitated careful timbering in built-up areas to avoid cave-ins. There, space limitations prompted the design of a traveling gantry that straddled the trench and was equipped with an overhead beam or runway and electric hoisting gear for muck buckets into which the excavated material was loaded in the trench. The buckets discharged into a large rectangular tilt-type hopper that was a part of the crane and dumped the material directly into trucks for disposal.

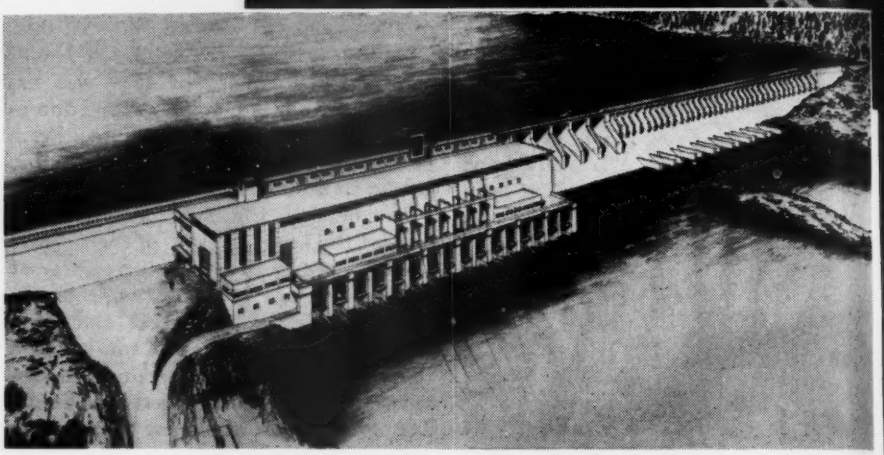
By May, 1949, when all but a few short sections of the drainage system had been finished, the complicated work of connecting the various branches with existing sewers was begun. These operations were completed on schedule, and on October 4, twenty-three years well-nigh to the day since the Bootle Council met to discuss the problem of flood relief, the Rimrose Brook Main Drainage Scheme was officially dedicated.

Since this article was written, the second part of the Rimrose Brook Drainage Scheme has been awarded to The Norwest Construction Company Ltd., and work on it is now underway.



GENERAL ARRANGEMENT OF STRUCTURES

Dotted lines mark the river banks as they existed prior to the beginning of work and also show where the diversion channel was cut through rock on the Quebec side. When the dam is in operation, water will cover the shaded areas.



AS LA CAVE DEVELOPMENT WILL LOOK

Architect's drawing of 2500-foot dam and 144,000-kw. powerhouse as they will appear about a year from now.

Ottawa River Power Development

La Cave Project Notable for Fast Excavation With Quarrymaster Drills

Allen S. Park

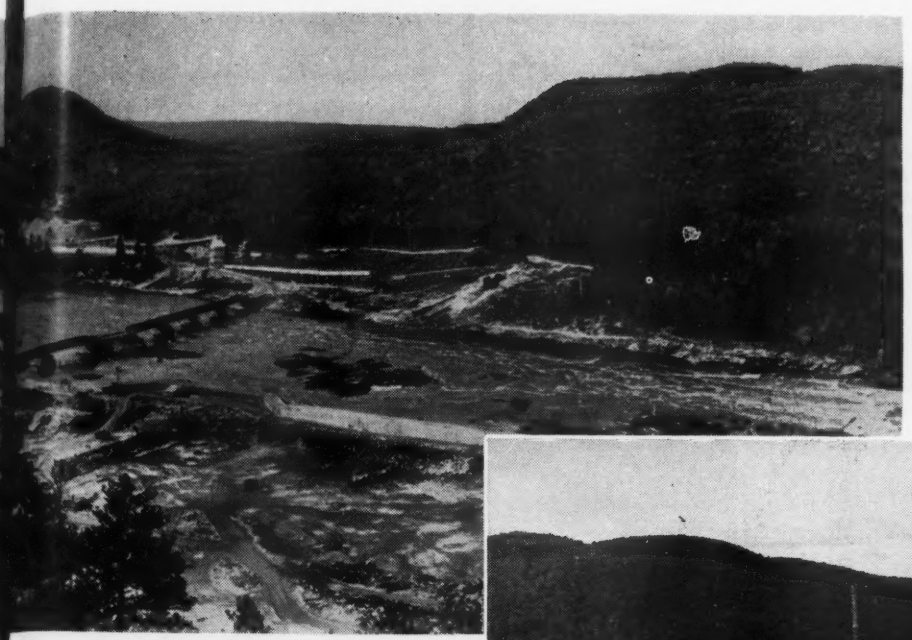
THE LA CAVE development, third large power project in the current construction program on the Ottawa River being carried out by the Hydro-Electric Power Commission of Ontario, is located 123 miles upstream from the Chenaux plant which was described last month and 63 miles above the Des Joachims development covered in our October issue. It is 5 miles from the village of Mattawa in a heavily wooded area not far from Lake Nipissing, a section favored by sportsmen and outdoor enthusiasts, and is being built at a cost of $55,000,000.

There, a straight gravity concrete dam 2500 feet long and with a maximum height of 130 feet is being thrown across the La Cave rapids. Following the Hydro Commission's usual pattern, the powerhouse will be constructed just downstream from and integral with the dam. The initial installation will consist of six 33,000-bhp. turbines, each driving a 27,000-kva. generator and providing a total capacity of 144,000 kw. Provision is being made for two similar units to be added later. The dam will back up the water 30 miles, forming a reservoir with an average width of half a mile and a full-pool area of 12,000 acres. The turbines are rated for operation under a head of 77 feet.

Production of power is scheduled to begin in January 1952, with one unit in service. The five other generators will go on the line within a year. The location is such that the plant can deliver current into both the Southern Ontario and Northeastern Ontario distribution systems. A 230-kv. transmission line will tie La Cave in with Des Joachims, on the south. A transformer station at La Cave will step down some of the power to 115 kv. for delivery to Sudbury, center of the International Nickel Company's huge mining and ore-reduction operations.

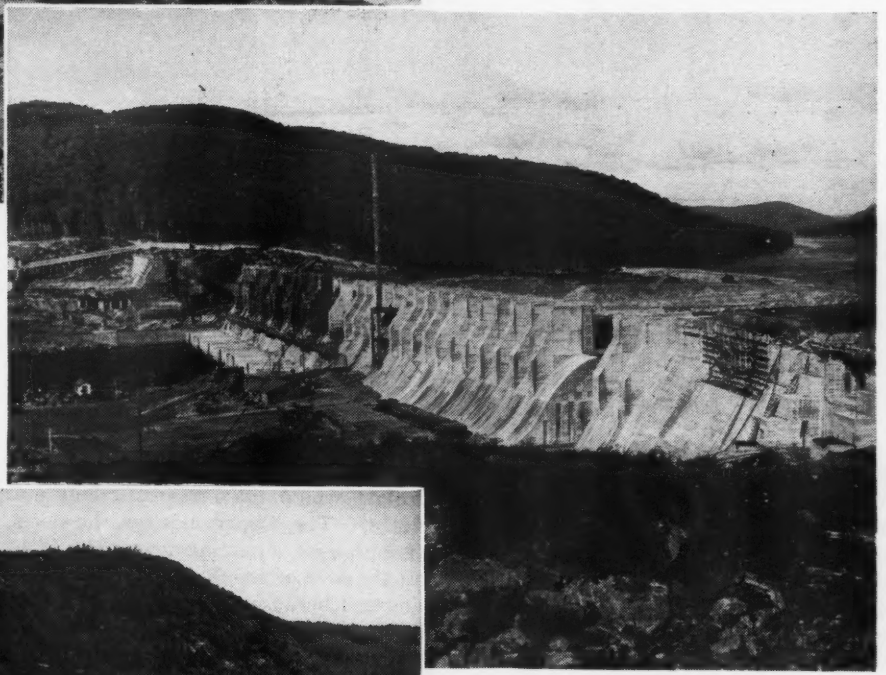
As an accompanying sketch shows, the Ottawa River is the boundary line between the provinces of Ontario and Quebec at the site under consideration. The dam, extending across a valley that has well-defined banks, will have a spillway section, 1240 feet long, mostly on the Quebec side, with the powerhouse toward the Ontario shore. The spillway will consist of six 40-foot-wide sluices fitted with control gates and of forty-two 16-foot-wide passages closed with stop logs. Combined, these openings will have a discharge capacity of 140,000 cubic feet per second, well in excess of the greatest flood flow on record. The dam and power plant will require 370,000 cubic yards of concrete and 15,000 tons of steel. Some 10,000,000 board feet of lumber will enter into concrete forms and other structures incidental to the job.

Preliminary surveys and diamond drilling at the dam site to determine the nature of the foundation rock began in the late summer of 1948. During the en-



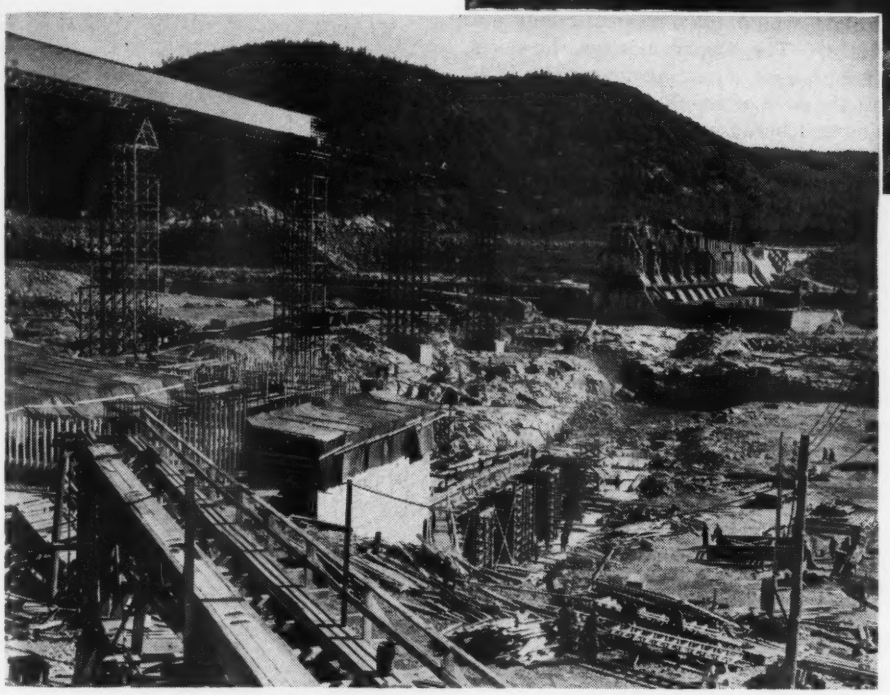
THE DAM TAKES FORM

The progress pictures appearing below were taken from opposite sides of the river on September 19. The upper one is a view from the Quebec side showing the sluiceway section of the dam in the foreground, the diversion channel in the middleground, and the powerhouse site near the far shore, with a section of the aggregate conveyor system on the hillside. The other picture shows the powerhouse site in the foreground with some rock excavation going on just beyond it. At the left, structural steel that has been erected for placing concrete in that section of the dam gives an idea of the ultimate height of 130 feet that will be attained.



PANORAMA AT DAMSITE

Taken soon after construction began, the picture above shows the diversion channel near completion in the foreground, the aggregate-preparation and concrete-mixing plants on the opposite shore, and a bridge erected downstream from the dam site to facilitate construction.



suing months, timber was cleared from the construction area and necessary grading done to provide access roads and sites for buildings and quarters for workers. Staff members and their families occupy white houses arranged in several rows in a wooded section on the Ontario side and dubbed "Riverside Drive." Bunkhouses for single men, a commissary, a cafeteria, and a recreation center are also included. Food is carefully selected to insure a well-balanced diet and is served by girls. A recreation association schedules motion pictures and dances, and facilities are available for bowling, billiards, reading and writing. The labor force has reached a peak of 1775.

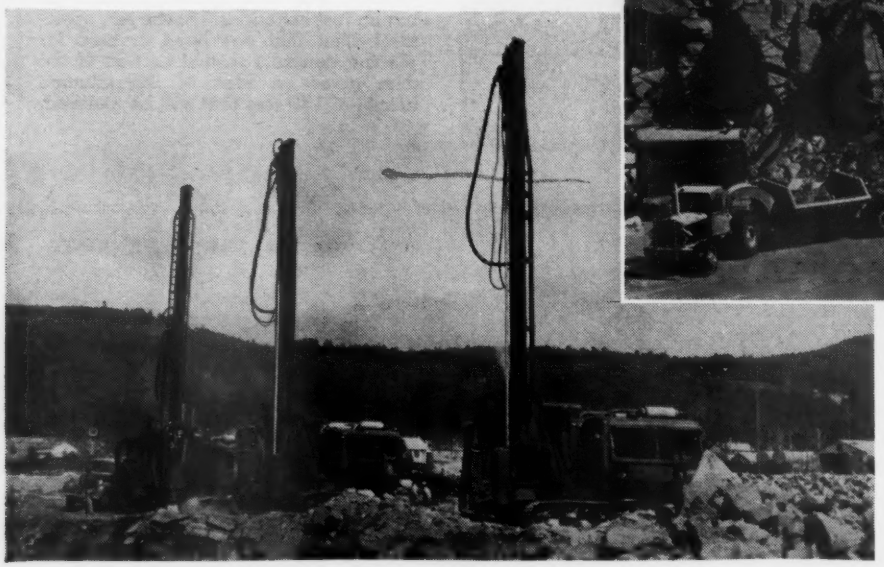
The general scheme of operations called first for the excavating of a channel through the east or Quebec bank of the Ottawa to divert the stream flow. Piers for the sluiceway section of the dam, which crosses this channel, were poured before the final upstream rock plug that held the water back was taken out. Cofferdams, which had been erected at the upstream and downstream limits of the construction area, diverted the river through the channel so that excavating for and building of the main body of the dam and the powerhouse could proceed in the dry.

The diversion channel necessitated the removal of 790,000 cubic yards of solid rock from an area 2500 feet long and ranging in width from 360 to 434 feet. The Commission was ready to go ahead with this phase of the project in the spring of 1949. It elected to excavate approximately 190,000 cubic yards along and adjacent to the dam line with its own forces and to contract the remainder. The low bid of approximately $1,200,000 was entered by C. A. Pitts General Contractor Limited, of Toronto, Ont., and that concern was awarded the work on March 28.

It was essential that the channel be completed before winter set in, and a rigid time limit—November 1—was therefore embodied in the contract. The

HEAVY DRILLING

Called upon to excavate 600,000 cubic yards of rock from the diversion channel in 6 months, the contractor attacked the job with large-capacity equipment and finished on schedule. Three Quarrymaster drills did the bulk of the drilling, and permitted taking out material ranging to 32 feet in depth in one lift. Wagon drills were also employed, mainly for line-hole work, and Jackhamers blockholed oversize boulders for secondary blasting.



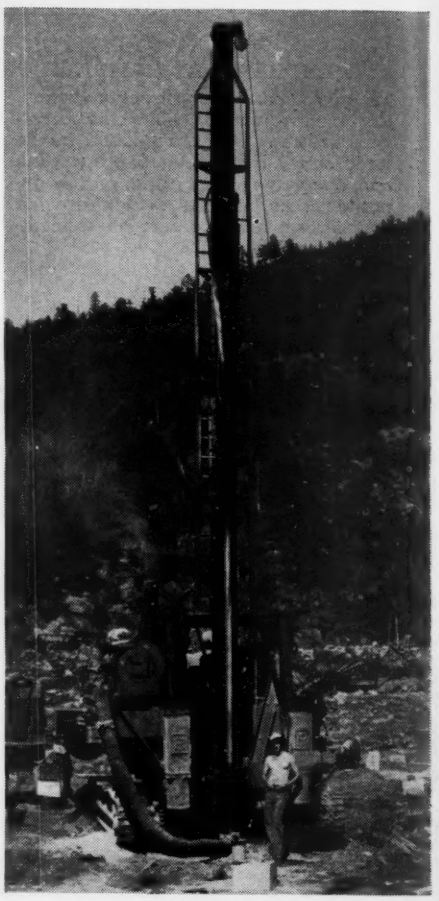
firm, in turn, was anxious to finish the La Cave job within the specified period because it had previously undertaken to excavate 800,000 cubic yards at the Des Joachims site between the late fall and the beginning of the following summer. Faced with two contracts, which involved the handling of 1,400,000 cubic yards of rock that had to be disposed of in thirteen months, the Pitts organization decided to outfit itself with the best equipment obtainable for fast, dependable operation.

As the crux of the problem was to drill the rock as quickly as possible, this phase of the work was carefully studied. Conditions indicated that best progress could be made by doing the bulk of the drilling with Quarrymasters—mobile, self-contained, large-hole rigs that had recently been introduced by Ingersoll-Rand Company. Consequently, three of these machines were purchased, along with smaller drills, three power shovels, and twenty diesel-engine trucks. In all, approximately $1,000,000 worth of equipment, most of it new, was assembled for the attack.

The nature of the material to be excavated was one of the main reasons for choosing Quarrymasters. The entire area was covered with an overburden ranging from 1 to 6 feet deep, presenting an irregular surface and containing numerous boulders and tree stumps. Underneath this mantle was granite gneiss, sheared in places, and broken into large blocks by slips and seams. With conventional drilling equipment, considerable stripping would have been necessary and drilling would have been difficult and costly. The Quarrymasters, however, gave promise of putting down holes without the need of much preliminary stripping and, because they can penetrate to a depth of 70 feet, of permitting the deepest material to be easily taken out in one lift. Moreover, it was figured that the drilling and powder crew required would be only about 15 percent as large as if wagon drills were employed.

The channel area was divided into three sections, two for excavating by Pitts' and the other by the Commission's forces. One of the contractor's sections was 700x434 feet in extent, with an average depth of 24 feet, and the other 1500x360 feet, with an average depth of 26 feet. The maximum depth in both was 32 feet. To open up long working faces that would afford many points of attack, Pitts first made a pilot cut about 175 feet wide in each division. These were widened out as desired, thus insuring the great flexibility of operation essential to volume production.

Ramps 50 feet wide and on an 8-percent grade were angled into the cuts at various points, giving trucks adequate access and permitting good hauling balance to be maintained among the various areas being worked. Disposal areas were at an average distance of 2500 feet from loading points, and truck speeds of 25 to 30 miles an hour were the rule on haulage roads. Water and calcium chloride were used to compact the gravel roadbeds and to lay dust, and a grader patrolled the roads continually to even up surfaces. A skilled tire mechanic was always on duty to make repairs without delay.



QUARRYMASTER CLOSE-UP

This machine is a self-contained, self-propelled large-hole drilling rig that carries its own air-compressing plant and is capable of putting down holes 70 feet deep. The figure of the man gives an idea of its size. The hose in the foreground carries cuttings blown from the hole to a storage container, thus eliminating the dust menace.

Although the contractor's advance guard was on the ground on April 15, the

entire plant was not assembled until June 1, at which time only about 10 percent of the rock had been removed. Thereafter, a schedule of more than 100,000 cubic yards a month was maintained, and the job was finished on time. According to Pitts, the Quarrymasters were mainly responsible for that achievement. After the conclusion of the La Cave contract, the drills were moved to Des Joachims and again played a major part by completing excavating there on schedule.

When the Des Joachims job was about ended, the company, with no other contracts in sight for the time being, offered the drills for sale or rental. In a mailing piece prepared for that purpose, it stated that "The Quarrymaster rock drill represents the most modern high-production and high-speed pneumatic drill available today. When placed on the market it immediately filled the gap that has existed during recent years in the heavy construction and quarrying industry. As improvements were made in shovels, trucks, and crushers with resulting lower unit costs, no appreciable change in drilling methods or machines was brought forward. The advent of Quarrymaster drills and tungsten-carbide bits by simplification of rock drill plant and lower unit costs has revolutionized the field of hard and semi-hard rock drilling.

"Through the use of Quarrymaster drills and tungsten-carbide bits, C. A. Pitts General Contractor Limited are presently completing the drilling and excavation of 1,400,000 cubic yards of rock (approximately 2,800,000 tons) in one year, well ahead of schedule and below estimated costs. One Quarrymaster can easily replace three or more churn drills or from five to eight wagon drills. Single-lift operations are possible up to a grade depth of 65 feet. Contractors can save the expense of stripping and removing costly overburden, as in many cases it is possible to drill without removal of the overburden. Winter work is particularly ideal for Quarrymasters and the usual costly problems encountered during the winter months are eliminated. The machines can easily be loaded on flat cars . . or "floated" wherever roads exist. Where no roads exist, they can walk over rough steep terrain under their own power."

At La Cave, most Quarrymaster holes were put down with 5½-inch Carset bits having tungsten-carbide inserts on their two cutting edges that cross each other at right angles. Each bit had a hole located off-center for introducing air to blow out cuttings and was attached to a 35-foot hollow steel by a standard tapered API thread. The loss of gauge during a day's drilling was inappreciable, and bits were usually resharpened at the machine with a hand-held pneumatic grinder taking power from the Quarrymaster's own compressor plant, which has a capacity of 834 cfm. at 130 psi. pressure. A drilling crew consisted of two men, an operator, and an oiler. Holes were normally spaced 15 feet apart in both directions, but this spacing was reduced to around 12 feet when the rock to be removed was less than 22 feet thick. For this shallower drilling 4¾-inch bits were often used, and drilling speed was faster than with the larger size. Holes were carried 5 to 6 feet below final grade.

For primary drilling, Pitts supplemented the Quarrymasters with eight wagon-mounted X-72 drifter drills of Canadian Ingersoll-Rand make. For the most part, they were employed along the edges of the cut to insure even faces. They also put in a few toe holes where

CARSET DRILL BIT

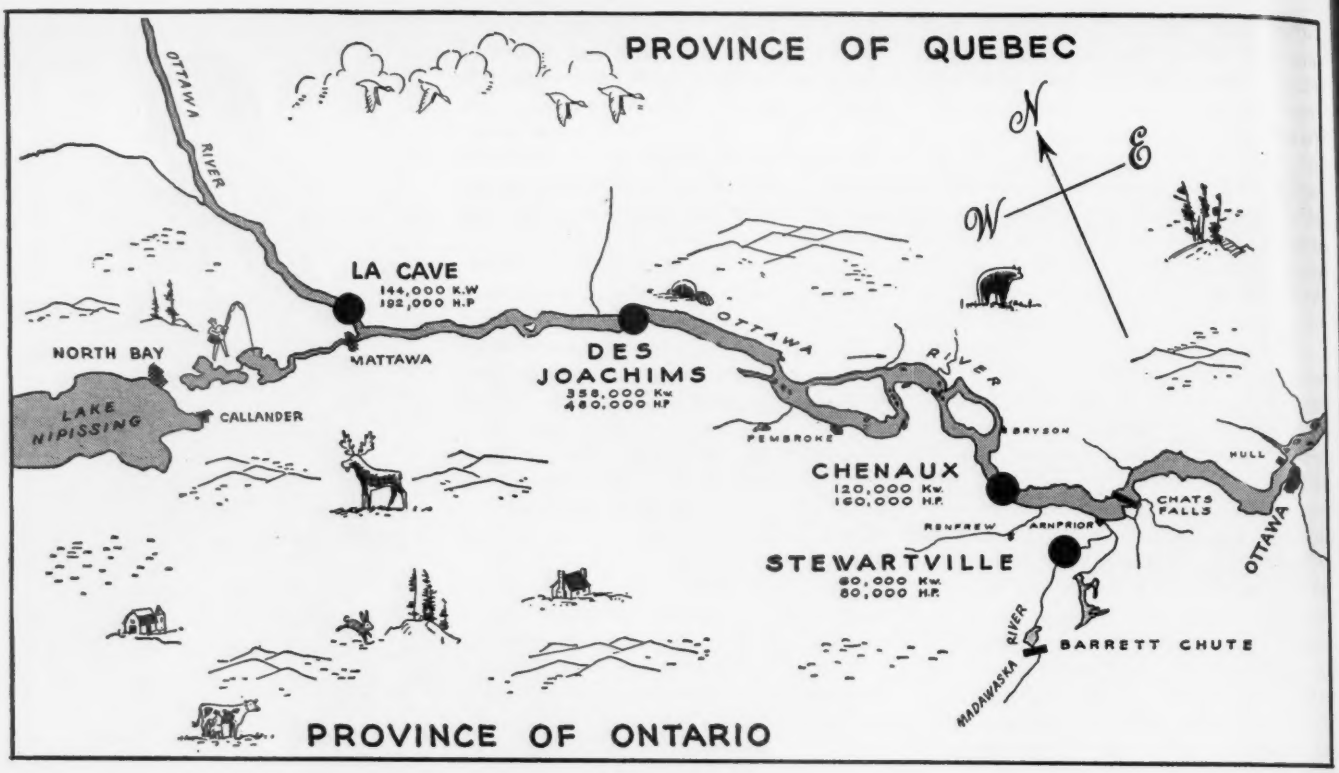
The use of bits having tungsten carbide inserts added to the effectiveness of the Quarrymasters. These bits lost little gauge in a day's drilling and were normally resharpened on the spot with a hand-held pneumatic grinder. Bits 5½ inches in diameter predominated, with some of 4¾-inch size used in shallower rock sections. The hole in the near side of the bit admitted air to the bottom of the hole for removing cuttings, the center hole being plugged.

that would assist in getting the full lift desired and improve fragmentation of the blasted material. After experimenting with various types of bits, the 2-inch Carset with tungsten-carbide inserts was adopted. Portable 315- and 500-cfm compressors supplied operating air for the wagon drills.

To break the blocky rock as uniformly as possible, high-velocity Forcite dynamite was used for all blasting. The cartridges varied in diameter from 5 inches in the 5½-inch holes to 4 inches in the 4¾-inch holes and 1½ inches in the wagon-drill holes. In the larger ones, the bottom 50 pounds of powder was of 75 percent strength and the remainder of 60 percent. The main charge ordinarily reached to within 12 feet of the collar of the hole, with additional loading up to within 4 feet of the top, at the discretion of the powderman. All holes were well tamped to get the powder's full effect and to reduce flying rock. The rock dust from the Quarrymaster holes, drawn off by suction into a collector, proved to be well suited for that purpose. Wagon-drill holes were charged with 60-percent powder. All 5½-inch-hole blasts were detonated with Primacord.

MOVING DAY

When the La Cave excavation had been completed this Quarrymaster, with its drill tower laid down over it, was run aboard a truck trailer to be transported 65 miles to the Des Joachims dam site. There it and its two companions, together with a fourth unit that was obtained on rental during the closing weeks of the work, drilled 800,000 cubic yards of rock in six months.



CHAIN OF OTTAWA DAMS

This drawing, prepared by the Hydro-Electric Power Commission of Ontario, shows the relationship of the power developments in the lower reaches of the Ottawa River area. The accompanying article describes construction at La Cave. Preceding ones dealt with the Chenaux and Des Joachims projects.

Despite careful attention to primary drilling and blasting, the nature of the rock was such that good fragmentation could not always be obtained, and this necessitated considerable secondary drilling to reduce oversize pieces so that the shovels could handle them. Thirteen Canadian Ingersoll-Rand J-50 Jackhamers were available for this work. The bulk of the blockholing was done by a 4-man crew using a truck that carried a 315-cfm. portable compressor and three drills with hose reels, bits, and other accessory equipment. A second 315-cfm. compressor and additional drills were employed when required. Powder of 40-percent strength in 1⅛-inch cartridges was used for blasting. The over-all powder consumption come to 0.87 pound per cubic yard of rock in place.

Broken rock was loaded by two Northwest 2½ and one Lima 3½-cubic-yard shovels, and a 1½-yard Northwest stripped overburden, loaded gravel for haulage roads, and cleaned up in the cuts. Haulage units, all of 15-ton capacity, consisted of eight Euclid and three Mack rear-dump trucks and nine Athey side-dump wagons that were drawn by tractors.

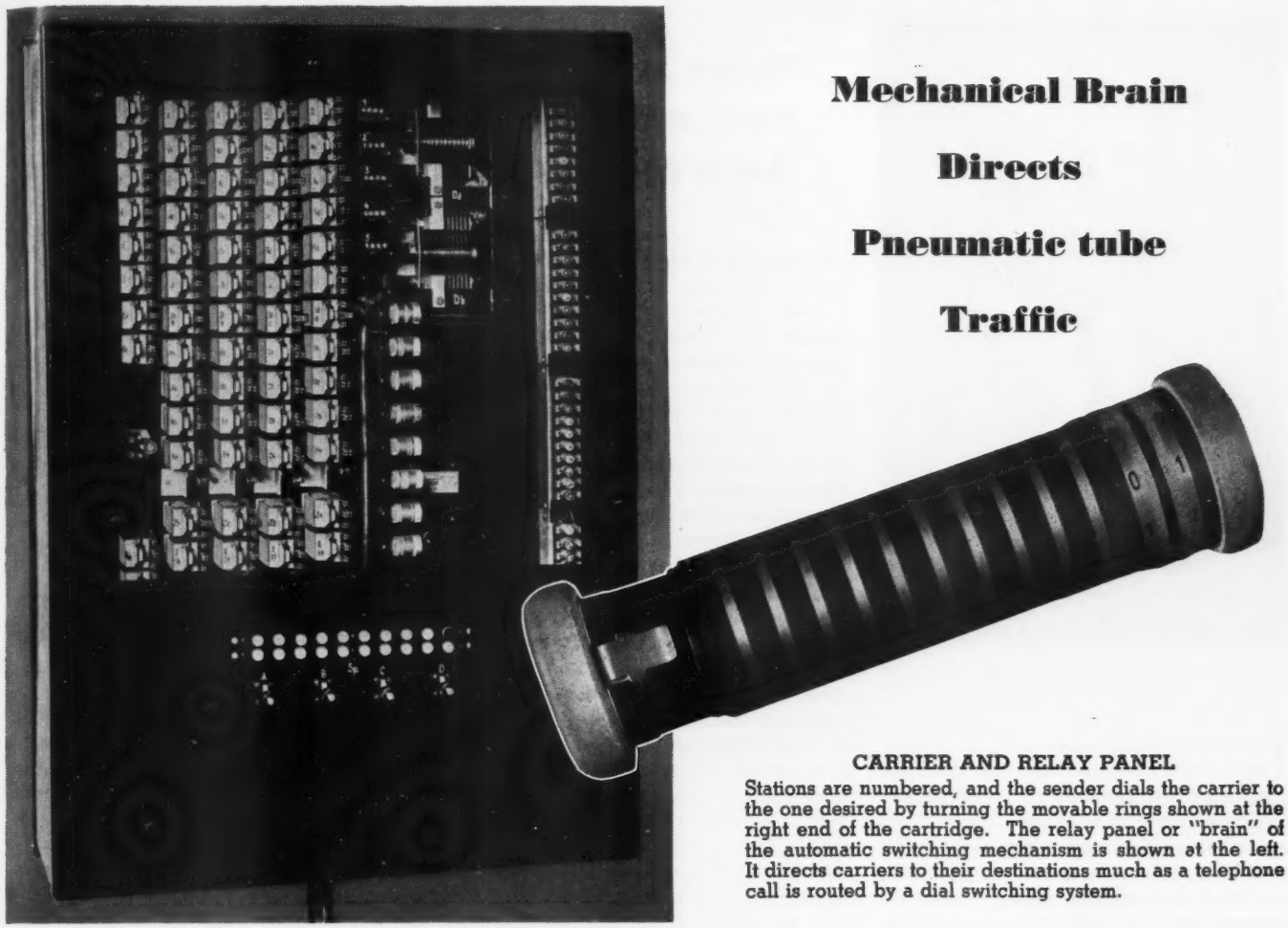
For its part of the channel-excavation work the Hydro-Electric Commission utilized nine Canadian Ingersoll-Rand wagon-mounted X-72 drifter drills and 2-inch Carset bits with tungsten-carbide inserts. Compressed air was piped from a central plant containing four stationary machines. One of the major operations was the removal of the rock plug left until last at the upstream end of the channel to keep the river out. This plug was 420 feet long, 40 feet wide, and varied in depth to grade from 10 to 15 feet. Its excavating entailed the drilling of 46,000 feet or nearly 9 miles of holes. There were 125 new bits on hand at the beginning of this work, and when it was completed eleven of them had not been used and fourteen were still serviceable. It is apparent, therefore, that each bit drilled an average of more than 400 feet. In the same rock, a conventional steel bit would drill around 4 feet before requiring resharpening.

Other excavating at the dam site by the Commission included approximately 40,000 cubic yards for the powerhouse and 107,000 cubic yards for a tailrace that is 2000 feet long and 425 feet wide. The project also involved the relocation of 37½ miles of line of the Canadian Pacific Railroad within the reservoir area and of 3 miles of highway between North Bay and Timiskaming, Que. The railroad job was contracted to Peacock & McQuigge Limited and Therrien Construction Company Limited. Another phase of the work called for the removal of some 400,000 cubic yards of earth 30 miles upstream from the dam site to improve the flow of the river in a stretch 4000 feet long. Construction of the dam and powerhouse is now in progress, and concrete pouring will continue without interruption until it is completed. About 600,000 tons of aggregates will be required, and most of this material is being obtained by crushing and screening rock excavated at the site. Aggregates of the several sizes needed are stockpiled separately above a tunnel and then dropped through gates for transportation by conveyor belt to the concrete mixing plant. The latter, which the men on the job have nicknamed "Chateau Frontenac," has a capacity of 120 cubic yards an hour. Concrete is delivered to the pouring locations by two methods: that for the powerhouse, which amounts to approximately 50 percent of the total, is transported by conveyor belt, while that entering into the dam is pumped through piping by pumpcrete machines. Concrete in place on September 1 aggregated 123,000 cubic yards, or 48 percent of the total.

W. B. Crombie is project manager at La Cave for the Ontario Hydro-Electric Commission, with B. Poyser serving as project engineer and N. Malloch as resident engineer. C. A. Pitts, president, directed the excavating done by his firm, with S. C. Cooper as chief engineer and L. Frankenfield as general superintendent.

This concludes a series of four articles on current hydroelectric power construction on the Ottawa River, which began in our September issue. The first article was general in scope, the second described the Des Joachims development, and the third the Chenaux project. Acknowledgment is made to the Hydro-Electric Power Commission of Ontario for many of the illustrations.

Mechanical Brain Directs Pneumatic tube Traffic



CARRIER AND RELAY PANEL

Stations are numbered, and the sender dials the carrier to the one desired by turning the movable rings shown at the right end of the cartridge. The relay panel or "brain" of the automatic switching mechanism is shown at the left. It directs carriers to their destinations much as a telephone call is routed by a dial switching system.

A PNEUMATIC tube system with a "mechanical brain" that routes carriers as directed by the sender has been put on the American market by International Standard Trading Corporation, an associate of International Telephone & Telegraph Corporation, 67 Broad Street, New York, N.Y. Patterned on the principle of the dial telephone, it rivals the latter in speed and efficiency. Although new on this continent, it has been manufactured for some years by Mix & Genest, a German subsidiary of I.T. & T., and is used successfully in Europe.

Unlike conventional tube installations that require separate sending and receiving lines between two or more stations, the M & G system provides full, automatic service between all stations. The defects common to manually operated systems are eliminated by common, automatically controlled loop lines, each of which begins at a central point and is connected to a number of stations. All carriers flow through their sending loops to this central control point, where they are automatically directed to their destinations by a relay panel—just as a telephone call might be routed under the dial switching system. Leaving the central station by way of the right receiving loop lines, the carriers are admitted selectively at their terminal stations by automatic switches.

A dial on each carrier enables the sender to forward it to any station in the system. The dial consists of movable rings on which are stamped digits from zero to nine. When these have been arranged to form the number of the receiving station, the carrier is inserted at the transmitter station and is moved through the tube by suction induced by a blower. When it reaches the central control point, it stops briefly while mechanical fingers contact the rings. As the relay panel or "brain" reads the signal dialed on the carrier it actuates the appropriate line and station switches and immediately diverts the carrier to the correct outgoing tube and station, where it is delivered through a receiver flap.

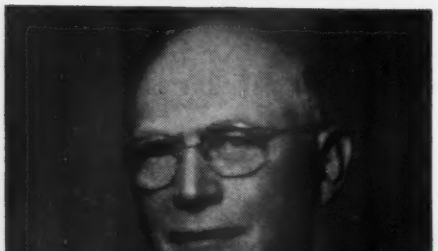
The relay panel not only determines the course of the carriers but also counts, for traffic-study purposes, the number that go through each loop, sees to it that there is sufficient space between traveling carriers, and flashes alarm signals to a supervisor should a failure occur in any part of the system. In addition, it controls a signal panel on which the lines in operation, the blower performance, blown fuses, or incorrectly dialed carriers are visually indicated.

Errors are well-nigh impossible. If a carrier is dialed for transmission to a nonexistent station, the central control device will dispatch it to any desired supervisory position, such as the telephone operator's desk. The number of stations that may be incorporated is practically without limit. A 40-station system can deliver as many as 1200 carriers an hour and is designed to meet the architectural requirements of virtually any type of building in existence or to be constructed. Various sizes of carriers are available. Compared with conventional pneumatic tubes, the new one needs less floor space and a reduced operating personnel. Moreover, as it functions automatically, it permits changing station locations without making tube changes and insures greater privacy in the handling of important messages.

Although it was designed primarily for department stores and industrial plants, the new equipment is well adapted for service in hospitals where records, prescriptions, medicines, etc., must often be dispatched with as little handling as possible. Other potential users include banks, government offices, newspapers, insurance companies, hotels, restaurants, post offices, railroads, and airlines.

The electrical part of the system is manufactured by Mix & Genest, while the United States distributor, Airmatic Systems, Inc., of 139 Charles Street, New York City, supplies all the other components and installs the equipment.

Moles to Honor Two at Annual Award Dinner



LESTER S. COREY

RAY N. SPOONER

IN EACH of the past eleven years two men have received awards for outstanding contributions to construction progress from The Moles, New York organization of tunneling and heavy construction men. The rules provide that one shall be a member and the other a nonmember. The 1951 member selection is Ray N. Spooner, treasurer of Allen N. Spooner & Sons, Inc., New York. The nonmember winner is Lester S. Corey, president of the Utah Construction Company, San Francisco, Calif. Formal presentation of plaques and awards will be made to them on January 31.

Born in Jersey City in 1893, and educated at Columbia University, Mr. Spooner entered construction work for the Pennsylvania Railroad in Philadelphia in 1913. A year later he joined his father and brother in their own firm, which at the time owned one piece of floating equipment. During the intervening years, the Spooners have engaged in various types of construction work, most of it around the water.

Undertakings in New York harbor have ranged from the building of bulkheads to the driving of a tunnel under the Passaic River. The concern is best known for its construction of docks and piers and has to its credit three on the Hudson River that are among the largest in existence. Work on them involved some difficult unforeseen rock excavation.

Mr. Spooner served as president of the New York General Contractors Association in 1934 when he was only 41 years old. He was the third president of The Moles, in 1940. He also has headed the Metropolitan Golf Roamers and Columbia Class of 1915.

Mr. Corey was born in Uintah, Utah, in 1880, and started work as a timekeeper for Utah Construction Company in 1901. He became vice-president and general manager in 1931 and president in 1940. During the past 20 years his firm has participated in many large construction jobs, among them Hoover Dam, Deadwood Dam in Idaho, Guernsey Dam in Wyoming, Bonneville and Grand Coulee Dams in Washington, and the east foundations of the San Francisco Bay Bridge in California. It also has been one of the leaders in railroad construction.

This and That

Record Caisson Claimed

What is reputed to be the largest pneumatic caisson ever constructed is being sunk at a point in the River Usk near Newport, England, to serve as the foundation of a pumping station for a steam-operated power plant. The condensers serving the turbines will require water flowing at the rate of 250,000 gpm., and as the tide causes the river to rise and fall as much as 44 feet daily the pumps will have to be stationed below the low-water mark in order to function at all times. Actually, they will be placed beneath the level of the river bed. The welded steelwork of the caisson weighs 580 tons, and the concrete walls of the pumping station are erected on top of it as it is sunk. They will be carried to a height 30 feet above mean high tide level to preclude the possibility of flooding the structure. Excavated material is hoisted by a 2-ton derrick through shafts provided with air locks. By the time the caisson is lodged on firm ground, its weight, including the superimposed load, will be somewhere near 40,000 tons.

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Pressure Tank Aids Stork

Pressurized air locks are now being used in some hospitals to start the breathing organs of newborn babies. About one infant out of eighteen does not begin to breathe normally at birth and requires resuscitation to prevent asphyxiation or suffocation. The new device is an improvement upon the mechanical and manual methods heretofore utilized to stimulate the action of the lungs, according to the Medical Society of the State of Pennsylvania. The child is placed in a tubelike tank having connecting compressed-air lines that permit raising and lowering the pressure rhythmically until breathing is regular. The pressure usually ranges from 1 to 3 psi. Heat and humidity in the chamber are controlled, and provision is made for admitting oxygen when necessary. The baby can be seen at all times through the glass sides of the air lock, which is kept heated in readiness for immediate service. One hospital credits the apparatus with having reduced the infant death rate from asphyxiation by 25 percent.

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Grinding Machine Anniversary

The pioneer industrial grinding machine built in this country was produced 50 years ago by Norton Grinding Company, now a division of Norton Company. The parent concern, then known as Norton Emery Wheel Company, had been making emery wheels, but cylindrical grinding machines as we now know them did not exist. However, Charles H. Norton, at that time a machine designer for Brown & Sharpe Company, of Providence, R.I., had recognized the need of one and brought his ideas to the Norton organization.

In those days grinding wheels were used chiefly as polishing tools, but Norton was of the opinion that they would also be suitable for removing substantial amounts of metal and, in many instances, supplement the lathe as a production machine. He constructed his first grinding machine with that purpose in mind, and it was successful. It was bought by R. Hoe & Company, of New York, and utilized for grinding printing press rolls. After it had been in service for 27 years, Norton Company reacquired it through purchase and presented it to the Edison Institute of Technology at Dearborn, Mich. It was accepted by Henry Ford and has been on exhibition at the school ever since.

During the intervening years, Norton Company has built 41,000 grinding machines based upon the original principle. For his accomplishments in the field of grinding, exemplified by 100 patents granted him, Charles H. Norton was awarded the John Scott Medal in 1925. He died in 1942 at the age of 91. Precision grinding machines today contribute to the manufacture of automobiles, airplanes, tractors, diesel engines, radio sets, washing machines, and countless other things that are widely used.

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Resin-Sand Molds Held Promising

Extensive development work is now being done in this country on a new process for making foundry molds and cores that originated in Germany. It is believed to be especially applicable to casting small metal parts and, as a large user of these, the automotive industry is reported to have spent in excess of two million dollars in bringing it to the pilot-line stage. Its use on a full production scale may be near. The process makes use of a sand-resin mixture to form molds around metal patterns instead of by the conventional method of ramming sand around a wooden pattern. The *Industrial Bulletin* of Arthur D. Little, Inc., reports on the innovation as follows:

"Although there are many modifications of the new process, a typical example uses a mixture of 100 parts of dry sand and 8 parts of a thermosetting phenolic resin binder. A metal pattern is treated with a silicon resin, much in the manner of greasing a cake pan, and is then heated; the resin-sand mixture is dumped on the hot pattern, where it builds up to a thickness of ⅛ to 1 inch. The excess resin-sand mixture is shaken off and used again. The pattern, covered with the thin layer of the resin-sand mixture, is heated in an oven for one to four minutes until the resin is set, forming a thin shell over the pattern; the shell or 'half-mold' is then removed from the pattern. Cores to fill hollow spaces in the final product are made by blowing the resin sand mixture with compressed air into a split heated metal core box. Two of the half-molds, together with cores, if required, are assembled to make the complete mold. This is embedded in a box of steel shot, where it can receive the molten metal. The shot supports the shell and serves to control the heat of the molten metal; the resin-sand shell is sufficiently porous to allow escape of the gases, and no special vent is needed.

"It is claimed that sections as thin as 0.010 inch can be poured and, with care, tolerances of 0.002 to 0.003 inch for small castings can be achieved, thus lowering machining costs and saving metal. The method has been used successfully for castings up to 100 pounds, and it is expected to be most useful for mass production of identical and relatively small castings for automobiles, tractors, and farm machinery. Such items as door handles and exhaust valves are commonly cast, and savings in this operation could be substantial.

"The volume of sand necessary for making molds can be reduced by 90 percent; machining and cleaning costs are claimed to be cut by as much as 80 percent; improved working conditions result from the relative freedom from excessive dust and heat; more efficient handling of materials and better use of foundry floor space are also claimed. Hardened molds can be made ahead of time and stored until needed."

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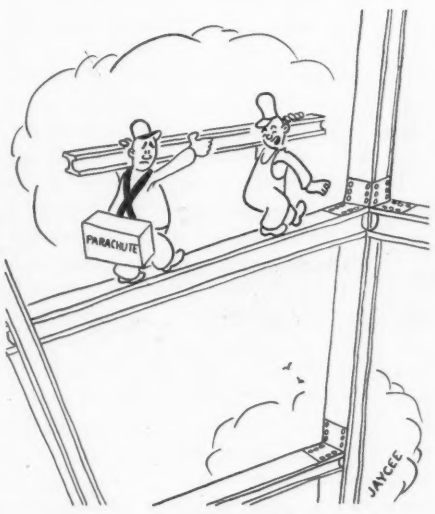
Reopening Old Mines In Turkey

Technical assistance furnished under the Marshall Plan is paving the way for reopening lead mines in Turkey that have not been worked for 1400 years. An American consulting engineer, R C. Rutherford, of Los Altos, Calif., is now on the ground planning the resumption of mining and the construction of a smelter to treat the ores Two old mines are of especial interest: the Bolkardag, which yielded arsenical ore containing gold, silver, and lead; and the Keban, strictly a lead producer. Crude tools found in the Bolkardag indicate that it was last worked around 600 A.D., and the Keban has probably been dormant equally long. Turkey now imports all the lead she uses, but is known to have substantial undeveloped deposits. If the initial development plan works out, other mines may be established.



"New at this type of work, eh?"

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Canadian Mine Down 7850 Feet

The deepest mine working in North America—an internal shaft of the Lake Shore gold mine in Canada—is now bottomed at 7850 feet below the surface. The lowest working level will be at 7825 feet, which is 625 feet deeper than the bottom of the neighboring Wright-Hargreaves Mine. The lowest present Lake Shore producing level is at 7325 feet, which means that the shaft extension has opened up an additional 500-foot vertical zone. In preparation for mining this, five new working levels will be developed at 100-foot intervals, to be followed by opening stopes, and providing ventilating connections and ore passes. The shaft has been deepened in accordance with Lake Shore's plan of taking a little ore at a time from each of a great many locations. This policy was adopted several years ago to reduce the incidence of rock bursts caused by too rapid removal of ore, with the consequent "popping" of the enclosing rock under the high pressure prevailing at depth. Under the new mining scheme, production has declined somewhat, but still exceeds 1000 tons a day.

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Record Bridge Planned

A suspension bridge that would eclipse any in existence has been designed for spanning the Straits of Messina between Italy and Sicily and will perhaps be built if financial arrangements can be made under the Marshall Plan. The design, prepared by D.B. Steinman, New York bridge consultant, calls for a central span of 5000 feet, which is 800 feet longer than that of the Golden Gate Bridge at San Francisco, now the longest. Piers would have to be sunk through an unprecedented depth of 400 feet of water, probably by the open-caisson method. The structure would require 46,400 tons of steel for its wire cables, 74,500 tons of other steel, and 567,000 cubic yards of concrete.

Editorials

HYDROCARBON JUGGLERS

IT IS possible, according to Gustav Egloff, a leading petroleum technologist, to obtain around half a million products from crude oil and natural gas. No one has taken the pains to figure how many of them are now being turned out, but the list is a long and growing one. These are things aside from fuel and lubricants and they come under the heading of chemicals. All of them originate in base materials that consist of hydrogen and carbon molecules, and the end products differ largely in the proportions of these elements and the ways in which they are combined. Most of them have come on the market in the past 25 years and in that period their total annual output has grown from 75 tons to more than 1,500,000 tons.

The industry that produces them is called petrochemistry and it embraces numerous concerns that utilize countless processes and techniques. To convert natural compounds into others of different chemical constructions, they call upon heat, pressure, catalysts, and various other agencies and devices that make up specialized methods of transformation bearing such names as alkylation, hydrogenation, sulfonation, halogenation, nitration, polymerization, etc. Although these chemicals utilize as their base materials only one two-hundredth of all petroleum and natural gas produced in the United States, petrochemistry is of such size that *Oil & Gas Journal* recently devoted an entire issue to it.

Among the important petrochemicals is synthetic ethyl alcohol. At one time practically all of it came from grain; now 70 percent of the 160 million gallons produced annually comes from the hydrocarbon ethylene, which is probably the most used single raw material yielded by petroleum and natural gas. It is obtained by thermally cracking ethane and propane. Ethylene itself is used as an anaesthetic and for ripening fruit. It can be polymerized to produce the resin polythene, which is employed for insulating electric cables. Ethylene and glycol are combined to make an antifreeze liquid of which some 260 million pounds are sold annually.

Most of our methanol, which was once obtained solely by distilling wood, now comes from natural gas. Synthetic glycerine, unknown ten years ago, is now made in amounts up to 35 million pounds a year from propylene, a product of cracked gases. The oxidation of natural gas components produces formaldehyde. Acetone, formerly derived only from fermentation processes, is now made in amounts exceeding 400 million pounds annually by the catalytic dehydrogenation of propyl alcohol. By reacting hydrocarbons with chlorine, many useful substances are obtained. Chlorinated paraffin waxes are employed in compounds for flameproofing, waterproofing, and mildewproofing many materials, including textiles. The new wonder insecticides such as D.D.T. are obtained by combining chlorine and hydrocarbons. Neoprene rubber is a polymer of chloroprene, and most of the other synthetic rubbers are hydrocarbon polymer products.

The list might be indefinitely extended. Some of the petrochemical plants are owned by oil companies and some by chemical companies. Perhaps no such distinction should be made for a petroleum refinery is, after all, a chemical plant. In the section of the Gulf Coast stretching from Brownsville, Texas, to Lake Charles, La., 62 petrochemical concerns are operating 80 establishments that produce 125 organic and 50 inorganic chemicals that are used in large volumes. They represent an investment of $750,000,000, and this figure is expected to be doubled by 1955. In the Houston, Texas, area alone 20 firms have invested $390,000,000. And, apparently, the hydrocarbon jugglers have only begun their wholesale alchemy, for research staffs are adding to their repertory of miracles all the while.

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ENGINEERING CENTENNIAL

ENGINEERS from all over the world will gather in Chicago in September, 1952, to observe the centennial of engineering as an organized profession in the United States. Although the event is nearly two years in the future, plans for it are rapidly assuming definition under the aegis of the American Society of Civil Engineers, first of the four major national engineering associations to come into being. Eleven technical societies in this country and one in Canada have signified their intentions of participating and invitations are being sent to 60 additional groups in the United States and the leading ones in other countries.

Because modern engineering is so largely responsible for the industrial growth of America, an important feature of the celebration will be an exposition designed to tell the story of engineering and industry to the general public. It will not only depict the effect that technological advancement has had in giving this country the highest standard of living ever attained, but will also stress the essentiality of preserving the philosophy of free enterprise under which we have come so far. Appropriately, this exposition will be staged in the Chicago Museum of Science and Industry, which already contains scientific and industrial displays provided by many of the foremost companies in the nation. One phase of the presentation will be a permanent engineering exhibit designed to show the evolution of engineering during the past 100 years.

It is difficult to realize that engineering, as we know it, came along so rapidly. Prior to 1850, there were only military engineers. The first of these were concerned chiefly with devising bodily protection for soldiers and instruments of destruction to be used against enemies. Road and bridge building became, in time, an additional duty. With the advent of gunpowder, they were also called upon to develop fortifications.

In the colonial period, however, we lacked even military engineers and were obliged to utilize Europeans during the Revolutionary War. The U. S. Military Academy was founded in 1802 primarily to educate military engineers rather than army officers. Then, as now, it was under the supervision of the Corps of Engineers, U. S. Army. The latter organization was called upon to design and direct some of our first large construction projects, such as the Baltimore & Ohio Railroad. As recently as the 1850's, the scarcity of American engineers led to using British technicians for designing the North Western Railroad, now the Chicago & North Western System. Where there were double tracks, they specified that trains were to run on the rails to the left according to British custom, and that practice prevails to this day.

The first American engineering schools were founded in the 1820's and it was not until 1853 that a state university (Michigan) added civil engineering courses to its curriculum. The need for this training was heightened by the introduction of steam power, the demand for railroads, highways, and canals, and the rise of manufacturing industries. To distinguish them from military engineers, the first graduates were called civilian engineers. By 1852 civil engineering had reached a stature that promoted the organization of the American Society of Civil Engineers. Since then, technical training has been divided into many categories, and the trend still continues as witness recent designations such as electronic and nuclear engineers.

The world becomes increasingly dependent upon the engineering profession for progress and well being. It is fitting that the 1952 convocation should be held in a nation that has been reared on a foundation of democracy, with its fundamental precepts of free education and free enterprise. Nowhere else has a form of government arisen that produces comparable benefits for its people.

Sizing Fine Particles with Air

FOR many years the mineral industry has used a device known as the Infrasizer to determine the size of particles of ore that are ground so fine that even the finest of commercial screens cannot catch them. It works on the principle that particles suspended in a rising stream of air decreasing steadily in velocity will fall at the point where their weight overbalances the force of the air. Now comes word that H. E. T. Haultain, a consulting engineer of Toronto, Canada, and professor emeritus of mining at the University of Toronto, has, after fourteen years of experience and research with the Infrasizer, developed a new and improved model.

The original Infrasizer has seven metal cones of different diameters and lengths arranged in a rack in inverted position in the order of their size. The top of each cone is connected to the bottom of the next in line by rubber tubing. The first in the series is smallest in diameter and connected to a source of compressed air that enters at the bottom, while the largest-diameter cone discharges into a bag collector or is vented to the atmosphere.

In service, finely ground ore of known weight is placed in the first cone and the air is turned on. As it rises, it lifts the material and carries all but the heaviest particles with it into the next one. In its passage through the five other cones with their increasing diameters the velocity of the air decreases, dropping the heavier parts of its load progressively until, upon emerging from the last one, only the finest particles remain in suspension. After the material is drawn from the bottom of each cone it is weighed to determine the degree of grinding.

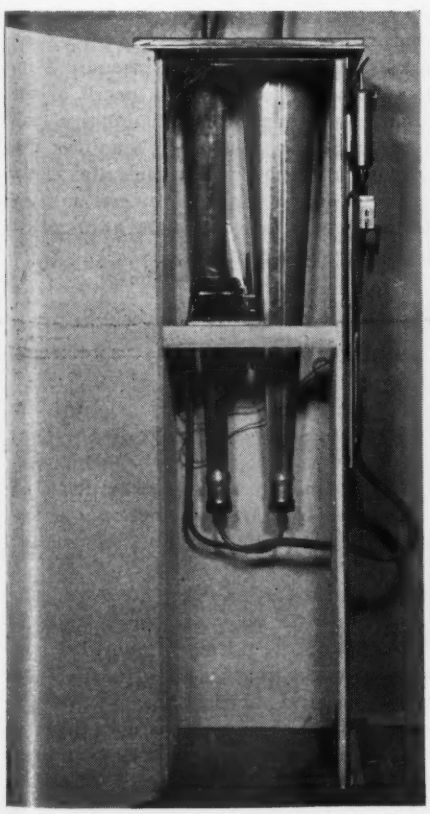
The new Infrasizer has only two cones which correspond to the second and fourth in the older type. Made of stainless steel, they are supported at the top and bottom by sponge rubber. An electrically driven tapping mechanism is provided by which each cone is periodically given a light, sharp tap to dislodge particles that cling to the sides. Both cones and tapping motor are housed in a soundproof cabinet.

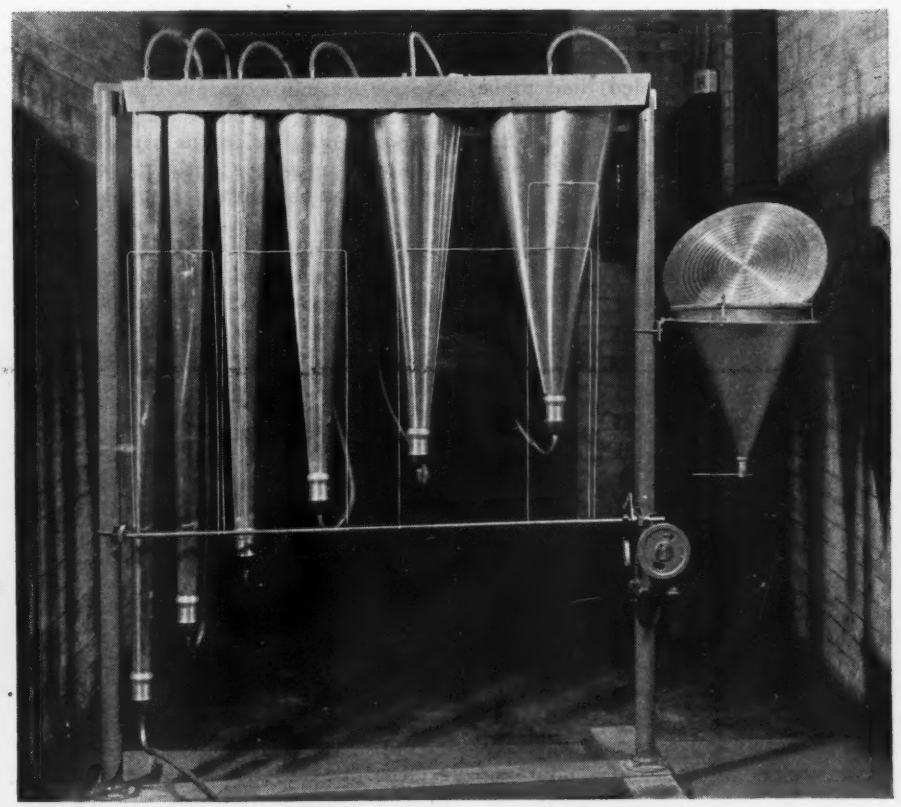
Clean air at a line pressure of not less than 10 psi. is required and may vary as much as 10 percent without affecting the results. It is regulated by two escape valves that are arranged in series and controlled by Sylphon bellows. At the bottom of each cone is a rubber plug with a conical piece inside instead of the ball used in the older Infrasizer. This serves as a valve for the admission of air and is more satisfactory than the earlier design. An orifice tube connected to a differential manometer indicates the volume of air passing through the cones, and an electric time switch is hooked up with the solenoid valve in the air system as well as with the motor operating the tapping mechanism. These controls are mounted on the outside of the cabinet.

As in the case of the 7-cone model, the air enters at the bottom of the smaller-diameter cone into which a sample of 25 grams of dry material is placed. With the electric timer set for a 30-minute run, the air is turned on. At the end of that time the air supply and tapping mechanism are automatically shut off and the sample is split into two products which, when drawn off and weighed together, indicate the degree of grinding. The fines or particles carried by the air escaping from the top of the second cone are caught in a dust collector or blown outdoors.

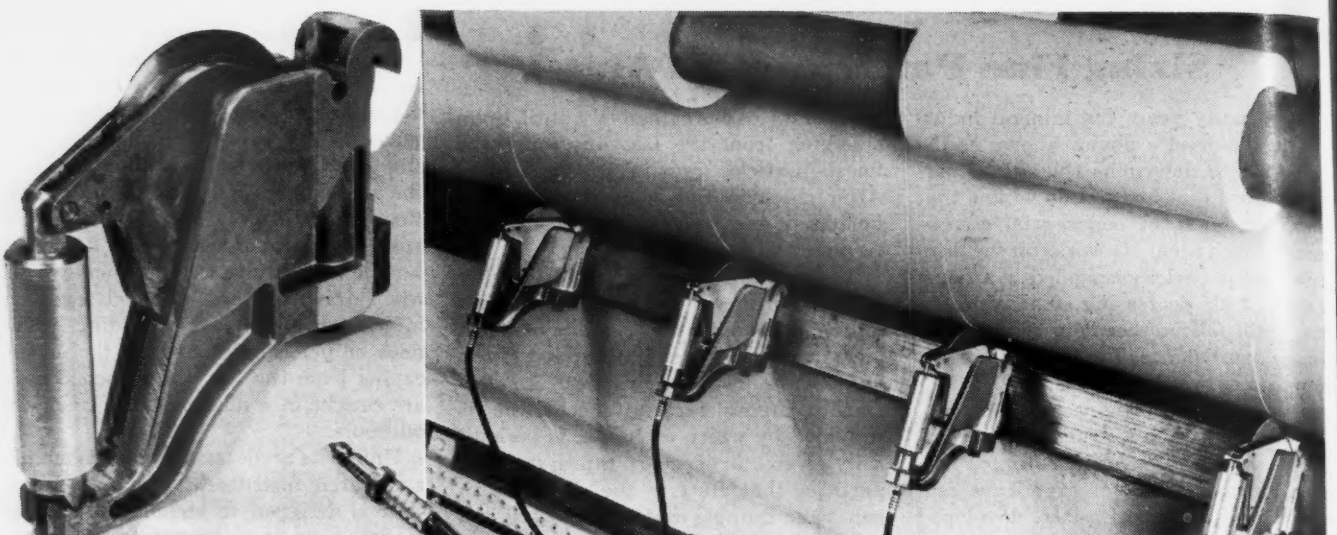
Unlike its predecessor, which is mainly a research instrument, the new Infrasizer is designed to enable mill men to make quick daily checks to determine whether they are grinding to correct size or not. Just as the distribution of sizes in a crushed homogeneous material follows definite laws, so does the distribution of sizes in a day-to-day mill operation follow definite lines. Cumulative graphs based on different degrees of grinding will be parallel, being higher or lower according to the degree of grinding. Hence one point on a curve is all that is required. Though one cone would suffice for the purpose of checking, two are used because experiments have proved that the weight of the combined products is a better index than the weight of a single product.

Condensed from an article by H. E. T. Haultain in the March, 1950, issue of "The Canadian Mining and Metallurgical Bulletin."





NEW AND OLD INFRASIZERS



SLITS AS ROLL IS REWOUND

At the left is a close-up of the Pneucut with the slitting wheel retracted. When compressed air is admitted to the vertical cylinder, the lever is pushed up by the piston and brings the wheel into cutting position. A group of slitters mounted on the spacing bar is shown above cutting a roll of material into strips the width of which can be varied by shifting the slitters. The latter can be substituted for spring-action units on slitter-rewinding machines in service.

Air-Operated Slitter for Rolled Material

BY SUBSTITUTING air for spring pressure, Cameron Machine Company has produced a slitter for paper, textiles, rubber, and plastic that has greatly simplified the work of cutting rolled stock into varying widths. By the old method, each unit (sometimes as many as 60 are needed) had to be set, and the slitting pressure applied was largely guesswork. Now the operator can set all simultaneously by turning a single control valve, thus causing them to exert uniform pressure on the web regardless of variations in the diameter of the cutting medium.

The device, which is called Pneucut, consists essentially of an air cylinder and of a cutter wheel attached to a lever. It is mounted on the spacer bar of a combination slitter-rewinding machine, the number used depending upon the width or widths into which the material is to be cut. They may be spaced on 1-inch centers, the minimum, and can be shifted for regrouping or removed by loosening a single screw. Below the bar is a manifold with numerous outlets into which are plugged the slitters' snap-lock hose connectors.

Opening the control valve of the assembly admits compressed air to each cylinder and brings its slitting wheel into working position by forcing the piston and attached lever upward. As the material passes between the sharp-edged wheels and the rotating back roll of the rewinder, it is cut into predetermined widths, the pressure applied depending upon the thickness and density of the material being processed. Thin tissues, for example, require less pressure than heavy-coated paper. As a result of the changeover, reports the company, roll production is increased, quality improved, and the slitter wheels and backing rolls are no longer damaged as they formerly were because of the application of too much pressure.

Electronic Tester for Mine Ropes

BEGINNING in 1947, the Nova Scotia Department of Mines, the Nova Scotia Research Council, and the General Engineering Company (Canada) Limited set out to subject all hoisting ropes in Nova Scotia mines to field tests with a modified cyclograph, an instrument in which a beam of light or cathode rays are made to move under the action of two controlling forces at right angles to each other to produce a figure or cyclogram on a screen. By February, 1950, electronic rope inspection had advanced measurably, and today the province operates a truck containing a cyclograph designed especially for the work and a recording dynamometer.

The truck is driven as close as possible to the hoisting rope and engine so that connecting telephone and power cables will not be more than 50 to 75 feet long. The dynamometer is put on the rope and indicates the actual pull in pounds with the rope running. The cyclograph, which remains in the truck, also operates without reducing the hoisting speed or holding up production and, through the rope's electromagnetic properties, makes it possible, it is claimed, to determine the safety of every inch of it. The instrument is sensitive to both internal and external stresses, the former attributable to manufacturing processes and the latter built up in service through stretching and locking of the strands—cold working.

All wires are penetrated in electronic inspection, and any change in the condition of the rope such as broken wires, reduction in wire area, splices, inserted steel cores, etc., are recorded on a chart. According to W. Simpson, inspector, Nova Scotia Department of Mines, it has been proved that charts can be obtained with the special cyclograph without interrupting normal operations and without damaging the rope in any way and that a study of these charts will show the condition of the rope or safety factor at all points throughout its length. The benefits of this information are obvious.

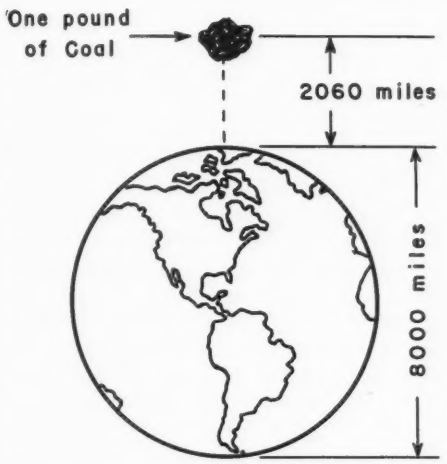
To What Height Could a Pound of Coal Project Itself?

NOW that the wonders of atomic energy and jet propulsion are being paraded before us day after day, the following thought-provoking question has been brought up: "How high would a pound of coal project itself if it could utilize all its energy in self-propulsion?"

Roughly, it is not difficult to determine that a pound of average coal has sufficient heat value to lift itself to a height of 2060 miles above the surface of the earth, as the writer has endeavored to show in the accompanying sketch. In jet propulsion, though, that answer is not correct because much of the pound of coal would be consumed by the time it reached 1000 miles or so. Obviously, the higher the lump rose, the lighter it would be, and less energy would be required to do the lifting. Besides, a pound of coal would not weigh a pound when 1000 miles above the earth because weight varies inversely as the square of the distance.

It has been computed that the heat energy in 2 pounds of average coal could raise a weight of one pound an "infinite" distance. At great height, to be sure, the earth loses its power of attraction and the weight would never come back to the earth. In making these computations, the lifting equipment was assumed to have an efficiency of 100 percent and air resistance was neglected. Such a problem is, of course, impracticable, but interesting and thought-stimulating.

Going back to our pound of coal, if it



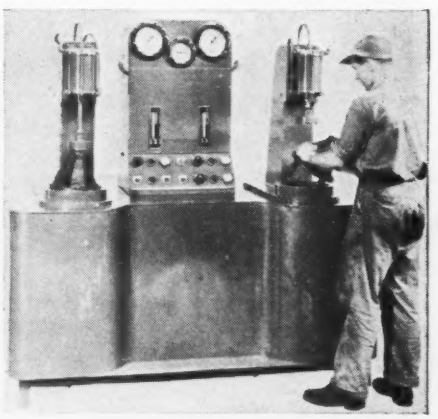
could raise itself by the jet-propulsion method, it is clear that the situation would be similar to that of an airplane on a long run. At the start of its journey a plane requires more gasoline per mile than at the end because it has been lightened by the amount of gasoline consumed. The difference between our pound of coal and the airplane is that the latter still exists at the end of the flight, whereas the pound of coal would be gone. The question posed in the first paragraph is therefore more or less a riddle because it "can't be answered."

The point the writer wishes to emphasize is the folly of doing heavy handling manually. Note the tremendous energy wrapped up in a single pound of coal. You, personally, can very likely carry 10 pounds with ease. But you couldn't readily raise it to a height of 2060 miles, nor even one mile. However, at the rate of $10 per ton you can buy 10 pounds of coal for five cents. That 10 pounds will do more hard work in a day at low efficiency than you could possibly do in the same interval at your best efficiency. So, isn't it foolish to try to compete with mechanical handling?

Air-Vacuum Test Machine

STAMPINGS and castings can be tested for leakage on a mass-production basis by means of a new vacuum machine announced by the Whittington Pump & Engineering Corporation. The unit pictured is installed in an automobile plant and is being used to test differential carrier housings. It is a 2-station model, the single operator unloading and reloading one while the other is in service, the housing remaining under vacuum for 24 seconds. The unit is designed to handle a wide variety of parts, each of which is handled in individual lots and requires a special rubber fixture that is shaped to seal all openings in the part when pressure is exerted on the fixture by a vertical pneumatic cylinder.

After the piece to be tested has been placed on the fixture at one of the stations, the machine works automatically, as follows: the cylinder piston descends; the casting or stamping is evacuated by suction induced by a vacuum pump; and two identical vacuum systems, each under the same predetermined vacuum, are established. If the part is sound, the two lines remain in balance and a green light on a central panel flashes "pass." But if it is defective, air is admitted to one of the systems, the balance between the two is upset, and a red light signals "leak." It is claimed that the machine can make 250 tests an hour.

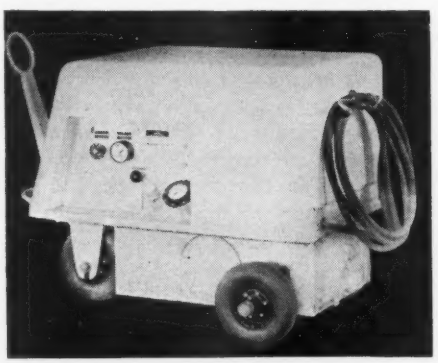


LEAK DETECTOR

Operator is shown unloading one station while the other is in service. The air cylinders exert pressure on rubber fixtures that seal the parts being tested by pulling a vacuum on them.

Air-Powered Oil Dispenser for Aircraft

TO INSURE safety when servicing fueled aircraft, Sprague Engineering & Sales has designed and in production a new air-operated oil dispenser. Self-contained and portable, it consists essentially of a 15-gallon oil reservoir and of an air tank constructed to withstand a maximum of 200 psi. When under a pressure of approximately 80 psi., it will deliver about 12 gallons of oil by aid of an air pump.



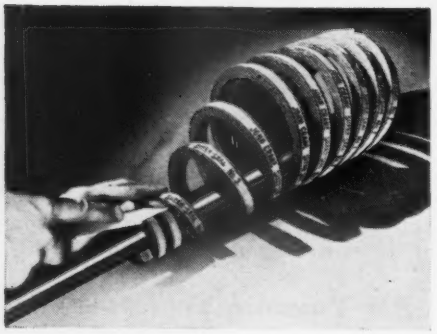
ELIMINATES FIRE HAZARD

This standard unit is equipped to dispense 15 gallons of oil without recharging the pressure tank with air. It carries 20 feet of hose, which is sufficient to service most airplanes.

To fill the dispenser's reservoir, its air tank is charged at the hangar; a suction hose is inserted into an oil barrel or supply tank; a 3-way air valve which is set at the "refill" position is opened; and the handle of a squeeze-type nozzle, which is attached to the other end of the hose and is turned into the reservoir, is depressed, allowing the oil to flow in freely. Before the vehicle is moved to the plane to be serviced, the air tank is recharged and the air valve is closed and set at the "dispense" position.

To transfer the oil, the valve is opened and the nozzle is introduced into the filler neck of the airplane reservoir and depressed. As the oil flows into the tank, it is cleaned by means of two micronic filter elements arranged in series, and because it does not come in contact with air, contamination and aeration are avoided. Gauges at the inlet and outlet of the filters register any drop in pressure, and indicators continually check the air and oil supply. Designated as the Model 277, the unit is 4 feet long, 2 feet wide, and 2½ feet high.

Industrial Notes



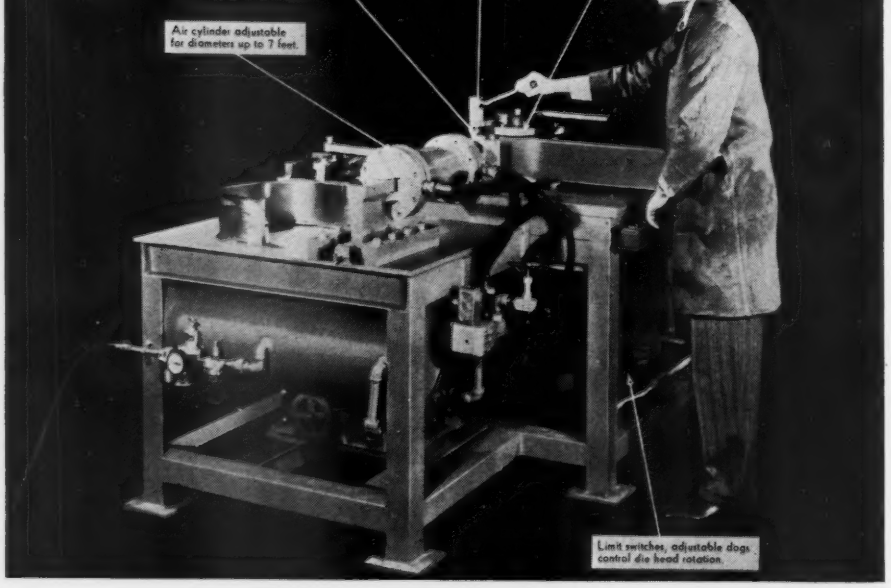
By giving its John Crane Super Seal line of plastic packings a securely vulcanized tape backing, Crane Packing Company has not only increased its flexibility but tagged it for identification. The reinforcing on each style differs in color and permits spirals to be twisted down to small shaft sizes for ring cutting without breakage. Made of asbestos, particles of antifrictional metal, flake graphite, and special binders, the packing is also said to be extremely resilient and homogeneous and not to harden at high temperatures.

Far more than ordinary visibility is claimed by McCord Corporation for its new prism-type gauge for use on its SF lubricators. Because of the angle of the prism and the refractive properties of the transparent plastic of which the gauge is made, it is easy to see how much oil is in the reservoir. This is important because lubricators are often placed where it is difficult to check the oil level.

As the result of a number of changes in design, Logansport Machine Company has increased the efficiency of its air regulator-filter-lubricator, according to a recent announcement. Known for short as R-F-L, it has a piston- instead of a bellows-type regulator, a synthetic filtering element in place of the porous metal one, and the filter cover and regulating valve that were formerly attached by means of small screws are screwed into the main body of the unit. Six inches square and 4¾ inches deep, it is installed in the intake from the main air line, but can be mounted on a central control board. It has three knobs on the front panel to regulate the air pressure and the amount of oil injected and

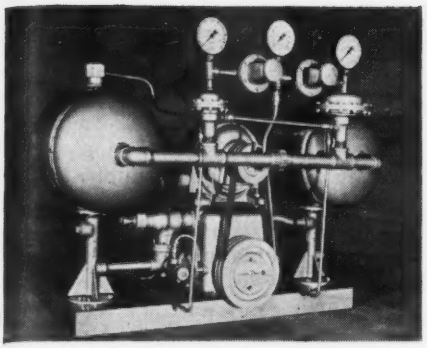
to drain the water trap, as well as a pressure indicator and an oil-level gauge. Use of the regulator-filter-lubricator is said to enable pneumatic equipment to operate at maximum capacity, to increase the life of packing, and to minimize wear on working parts.

Pines Engineering Company has announced a new rotary-fixture machine for bending irregular shapes or true radii in tubing, bars, extrusions, or roll-formed sections up to 8 inches wide used extensively in building automobiles, aircraft, metal furniture, etc. It features a horizontal, stationary, air-operated pad that exerts pressure against a rotating die head mounted on a heavy vertical spindle gear driven by a reversible 7½-hp. motor. The pressure pad, by obviating single-point contact on work pieces, acts like an ironing shoe and is said to insure smooth, wrinkle-proof bends. A clamp, moved by a lever, holds the stock while a 12-inch-stroke 6- or 8-inch air cylinder on an adjustable slide provides the power to make bends up to 7 feet in diameter. Limit switches and adjustable dogs control the degree of rotation of the die head during the operating cycle, and electric push buttons permit starting, stopping, or reversing at any point in the cycle. Changeover in tooling setup can be made by one man in 30 minutes. In the foreground on the work table of the unit shown is an 8-inch, 16-gauge window-type blower housing which has been given an average radius of 9 inches. The maximum radius for which the machine is designed is 3½ feet.


Cam-operated work clamp.
Rotating die.
Stationary pressure pad.
Air cylinder adjustable for diameters up to 7 feet.
Limit switches, adjustable dogs control die head rotation.

There is a growing tendency in industry to provide posture chairs for factory workers who sit at their daily tasks. Correct posture, as the medical profession tells us, is important from the health standpoint, lessens fatigue, and thus increases efficiency. Chairs of this type have been used for a long time by office workers and are now being made by Cramer Posture Chair Company, Inc., for industrial application. The concern has designed a line, identified by the name of Work-Flow Posture Chairs, that is said to make possible 100 and more combinations to meet all manner of seating requirements and the needs of short or tall, thin or fat persons. Included are chairs of ordinary height, high chairs with foot rings, padded or all-metal chairs, swivel chairs, a type that easily slides along the floor, and another that is locked to keep it in position. A flip of a lever changes the seat height and two controls adjust the back to whatever position is most comfortable and offers best support.

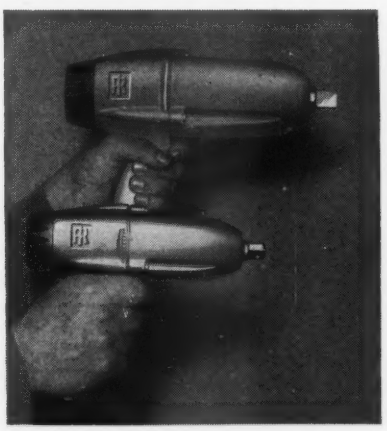
Simplicity of design and flexibility of control are points claimed by Oracle Engineering & Sales Corporation for its new Rialto Power Source for hydraulic molding presses. The heart of the unit is a by-pass sleeve that is moved in and out of pumping position by a snap-action



valve and causes two separate power units to develop individual pressures—low pressure for rapid-advance volume and high-pressure liquid for "dwell time." Both can be selected by regulating air pilots, providing line pressures from 0 to 6000 psi. and permitting the use of a simple valve for press control. The Model 200 is available in six sizes and pumps water, oil, etc., without generating heat. The unit will function wherever ventilation is sufficient for an electric motor.

To enable manufacturers and merchandisers to identify packaged products at a glance, Chippewa Paper Products Company is making its Chippaflex—a flexible corrugated material—in red, green, blue, and white. It is available in flat sheets, tubes, and 6- to 72-inch-wide rolls and is delivered in corrugated cartons to protect it in transit.

Two additions to its line of air-operated Impactools—Sizes 504 and 510—have been announced by Ingersoll-Rand Company. According to the manufacturer, the 504, a completely redesigned tool, is 20 percent more powerful and 60 percent faster than the older Model 504 and is so effectively muffled that it takes 100 of them to equal the noise of the latter. Besides running nuts on bolts up to ⅜ inch in size, it may be used within prescribed limits for multipurpose drilling, for reaming, tapping, driving screws, sawing holes in sheet metal, removing broken stud and cap screws, driving and removing studs, running wire brushes, etc. The Model 510, also muffled, is a new size designed for running nuts on bolts up to ¾ inch in size and for jobs where it is desirable or necessary to have one hand free to hold the work or to pick up the nuts. It is described as the most powerful tool of its kind for 1-hand operation. Both have vane-type air motors, built-in automatic lubrication, integral air strainers to keep rust, dirt, small bits of hose, etc., out of the motors, and large deeply grooved reverse caps so tools may be reversed fast even with greasy hands.

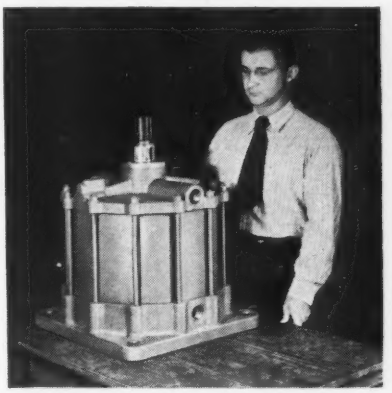


PISTOL-GRIP IMPACTOOLS
Size 510 (top) is 10⅞ inches long and weighs 11¼ pounds.
Size 504 (bottom) is 8 9/16 inches long and weighs 5¾ pounds.

Single- and double-span bridges for temporary use are now available in packaged form ready for assembly. They are fabricated by H. D. Campbell Company and are from 14 to 60 feet long, 6 to 16 feet wide, and have a carrying capacity of 5 to 15 tons. The smallest assembly has two 14-foot steel girders and the largest ten, each 30 feet long, with adjustable columns. Deck planking, which is bolted through holes in the girder flanges, is not supplied.

Allmul, a new Babcock & Wilcox product, is a refractory for lining high-temperature furnaces. Intended primarily for the manufacture of firebrick, it will soon be available in grain form and in a ramming mix. It is reported to have a melting point exceeding 3300°F., which is nearly one-third higher than that of steel. Firebrick heated to 3000 degrees will support 1000 pounds without deformation, and when successively exposed to 2550 degrees and sprayed with cold water will show no signs of cracking or chipping. The company also claims that the material will serve for a long period at high temperatures without requiring maintenance.

Large-diameter cylinders with cup-type pistons and chevron-type gland packings for use with air, oil, or water have been announced by Hannifin Corporation. Of new design, they are available in two sizes, 14- and 16-inch low-pressure units for 125 psi., air, or 160 psi., hydraulic, and in an extensive range of mountings with double-end rods in most styles. They are recommended for service where heavy forces are required, especially



where it is necessary to hold pressures for long periods. The 16-inch cylinder is said to exert 100 tons on a 100-psi-stroke. They are furnished with either chrome-plated rods or rods and bores. The unit shown is the 16-inch, 6-inch-stroke Type HLW air cylinder.

For the protection of pneumatic tools and air-control mechanisms from rust, dirt, and moisture, A. Schrader's Son has announced a new series of air-line filters —No. 3084—that features an element composed of hundreds of laminations of a fine newly developed material. The

SAUERMAN

Power Drag Scrapers

Photo shows Sauerman Scraper stocking out coal at large power plant. Building a high, compact pile 350 ft. in radius, this scraper stores and reclaims at rate of 250 t. p. h.

Whatever your material—ore, coal, boulders, sand, gravel, clay—you can move it fast and efficiently with a long range Sauerman machine of either cableway or scraper type—at a great saving in cost. Any mechanic can operate it. Upkeep is simple. Machine is flexible: range is easily extended. Sturdy design and construction for long service. Bucket sizes run from 1/3 to 15 cu. yd.; spans range up to 1,000 ft.

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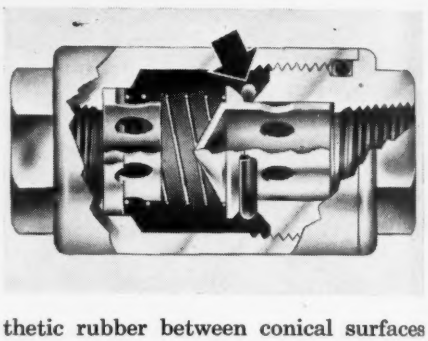
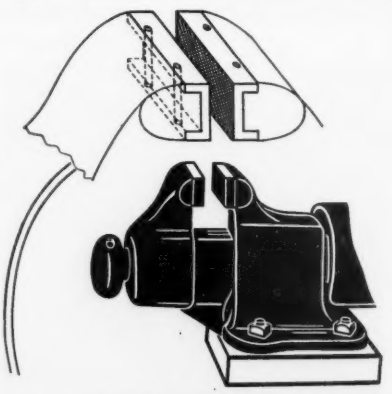
PIPE COUPLINGS AND FITTINGS

filtering area is said to be large enough to insure full air flow even after long periods of use. Trapped moisture is removed through a drain cock. The model is available in three standard pipe sizes —¼, ⅜, and ½ inch—and pipe connections are the straight in-line type.

Heretofore produced only on a custom basis for pneumatic and hydraulic systems, James-Pond-Clark's Circle Seal check valve is now a standard catalogue item made in a full range of sizes from ⅛ to 1 inch NPT. Two models are available for standard and for very low pressures, respectively. Both are of the poppet type using an "O" ring seal of synthetic rubber between conical surfaces on the poppet and valve housing. (Indicated by arrow in accompanying picture.) Claims made for the design are absolute sealing, minimum flow resistance, proof against leakage, and quick opening and closing at extremely low pressures. Opening pressures are as low as 1 psi. differential in the standard-pressure types and 4-inch water column in the low-pressure models.



Interchangeable jaw faces with either smooth or serrated surfaces are a feature of two new models, 457R and 457R-6, in Van Products Company's Vi-Speed line of air-powered vises. The faces are made of hardened tool steel and are firmly attached to the jaw castings by spring-tempered pins driven into holes drilled in a manner to bind both faces and pins. The latter are easily forced out with a punch to change faces or to mount special tools and dies. The new vises are especially recommended for work where the jaws might be exposed to heat, because the faces can be readily removed for rehardening and others substituted.



Books and Industrial Literature

To the many books on engineering, has now been added one on human engineering. Claimed to be the first systematic treatise on the science of designing mechanical equipment on the basis of detailed studies of human capabilities, it was in preparation for three years by the Tufts College Institute for Applied Experimental Psychology under a contract with the U.S. Navy's Special Devices Center. Designated as PB 100 814, *Handbook of Human Engineering Data for Design Engineers*, it consists of 500 pages and includes graphs, charts, and tables. It is sold by the Office of Technical Services, U.S. Department of Commerce, Washington 25, D.C. Price, $5.00.

Numerous gases widely used in industry are delivered under pressure in cylinders. To prevent the possibility of unintentionally making dangerous cross connections between cylinders containing different gases, the committee on valve-threads standard of the Compressed Gas Association has developed a standard that recommends detailed dimensions for all the elements of cylinder valve outlets and their connections. The threads on the outlets are separated into four basic divisions: internal, external, and right-hand and left-hand. Further separation is made within each division by varying the pitch and diameter of the threads. The diameters within each division are so spaced that adjoining sizes will either not enter or not engage. A numbering system for the valve-outlet connections is given along with 68 applications of these connections for the various gases. The standard, designated as B57.1-1950, is available from the American Standards Association, 70 E. 45th Street, New York 17, N.Y., or from the Compressed Gas Association, 11 West 42nd Street, New York 18, at $1.50 per copy.

A new type of prefabricated electrical switchboard, called Centra-A-Power, that concentrates power and lighting switching in one unit is described in Bulletin TEB-10 offered by Trumbull Electric Manufacturing Company, Plainville, Conn.

Bulletin 1250, issued by Young Radiator Company, Racine, Wis., describes shell-and-tube heat exchangers designed for cooling lubricating oil used by diesel locomotive engines and stationary diesel and gasoline engines in industrial applications. Designated as the A-800, the cooler is made in four sizes.

A 40-page catalogue on power chucks, air cylinders, air valves, and accessory equipment is being distributed by the S-P Manufacturing Company, 12415 Euclid Avenue, Cleveland 6, Ohio. Drawings and reference tables that will assist draftsmen and engineers in specifying the equipment for various applications are included.

The Fluor Corporation, 2500 South Atlantic Boulevard, Los Angeles 22, Calif., offers a bulletin, No. PDS-8501, describing its piping system for dampening pulsations produced in varying degrees by air and gas compressors. It is claimed that installation costs are not increased when the dampening devices are included in new construction.

Oil-bath air filters for use on the air intakes of air compressors and internal combustion engines are the subject of a new bulletin, No. FX-948, being distributed by Air-Maze Corporation, 5200 Harvard Avenue, Cleveland 5, Ohio. Available in ca-

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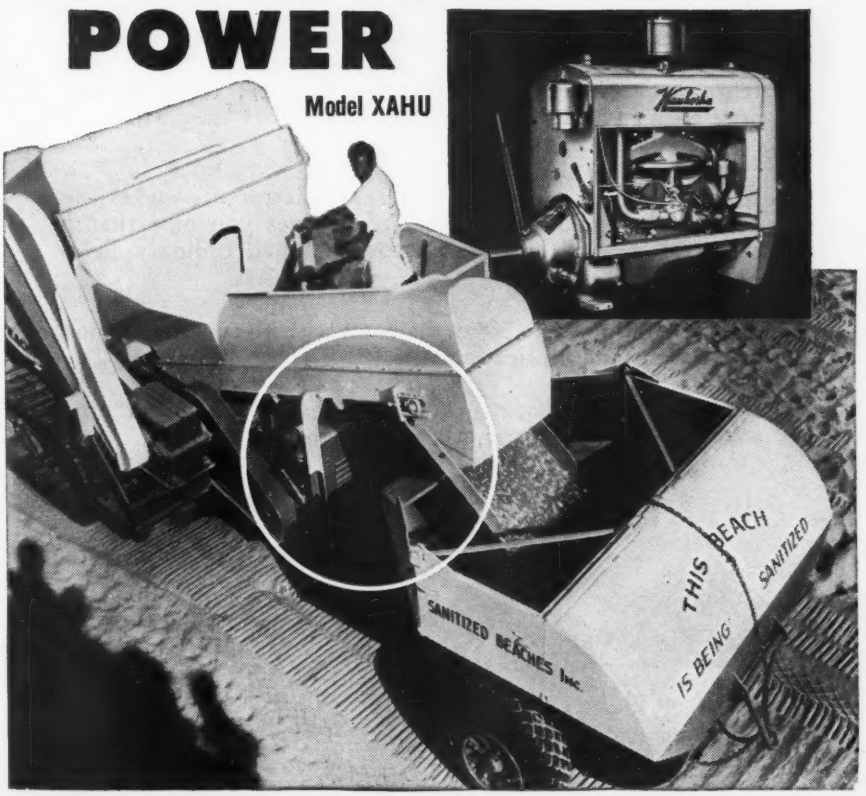
● You don't send a beach out to the cleaners. But take a look at this beach being dry cleaned. With Waukesha power! The top layer of sand, to a depth of nine inches, is being scooped up and screened . . . broken glass and other dangerous debris removed and articles of value recovered . . . and the clean sand, fluffed and aerated, is being replaced—by the *Beach Sanitizer* built by Sanitized Beaches, Inc.—a division of Stephens-Adamson Mfg. Co., Aurora, Ill. Powered by its Waukesha XAHU Gasoline Power Unit—4-cyl., 3⅝-in. x 4½-in., 186 cu. in. displacement; 43 hp. max. at 2000 rpm.—the *Beach Sanitizer* cleans a 6½-ft. wide strip of beach at a speed up to 1½ m.p.h., handling 2000-3500 sq. yds. of sand an hour. For details of this and other Waukesha Industrial Power Units, 8 hp. to 400 hp., send for Bulletin 1408.

WAUKESHA MOTOR COMPANY, WAUKESHA, WIS., NEW YORK, TULSA, LOS ANGELES

WAUKESHA POWER

Model XAHU



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pacities up to 6500 cfm., these filters have recently been improved in several respects.

Information on Palmetto packings previously available on individual bulletin sheets has been brought under one cover by Greene, Tweed & Company in an illustrated 20-page catalogue, which also includes data on several new products. Requests for the publication, on company letterheads, should be directed to the manufacturer, at North Wales, Pa.

The results of eighteen months of research on high-temperature lubrication are embodied in a folder, *Hi-Temp Oils*, issued by E. F. Houghton & Company, 303 West Lehigh Avenue, Philadelphia 33, Pa. It describes testing procedure followed in setting specifications for three series of special oils designed for service at temperatures ranging up to 500°F.

Information on the characteristics of various quenching mediums and instructions on their use are contained in a 12-page publication, *Quenching and Tempering Oils*, available from Esso Standard Oil Company, 15 W. 51st Street, New York 19, N. Y. The booklet is designed to enable metal workers to provide adequate quenching systems to meet their respective needs.

Bradford Steam Specialty Company, New Bedford, Mass., has issued a small folder describing its adjustable sprocket rim with chain guide. The product permits operating overhead or inaccessible valves and hopper devices from the floor and eliminates the need of climbing or building special runways or catwalks in order to reach them.

Twelve ways of using the Hagan ratio totalizer in automatic control circuits are described and illustrated in Bulletin 5450, available from Hagan Corporation, Hagan Building, Pittsburgh 30, Pa. The ratio totalizer is a pneumatically operated mechanism for accurately combining input control pressures and spring forces to produce a single output control pressure.

A 12-page illustrated booklet describing Sunvis H. D. 700 lubricating oils is available on request to Sun Oil Company, Philadelphia 3, Pa. These oils are offered for use wherever contamimation and rust are a problem and where bearings are operated under heavy loads. The booklet discusses the suitability of the oils for service in circulating and hydraulic systems, compressors, and gear boxes.

Synchronous motor-generator sets in capacities from 30 to 8000 kilowatts are described in Bulletin GEA-5506, available from General Electric Company, Schenectady 5, N. Y. These sets comprise a source of d-c power for many industrial services, such as operating motors for driving steel-mill rolls, mining and quarrying equipment, etc., and for the electrolytic refining of ores, and the excitation of d-c motors and generators.

Johns-Manville, 22 E. 40th Street, New York 16, N. Y., offers two new publications. One, titled *Roof Savers*, recommends methods and materials for normal maintenance of coated roofs and for repairing accidental damage to them. The second, *Build and Insulate With One Material*, describes Marinite, a Johns-Manville sheet material made up of asbestos fibres, diatomaceous silica, and an inorganic binder that is designed for the construction of ovens, driers, and other heat-encasing equipment. Marinite can be sawed, nailed, or screwed in place like lumber, and comes in four thicknesses ranging up to 1-inch.